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RESULTS OF THE ARCHBOLD EXPEDITIONS: No. 31

NEW RODENTS AND MARSUPIALS FROM NEW GUINEA

By G. H. ~~TATE~~ TATE AND RICHARD ARCHBOLD

The large collection of mammals assembled by the Archbold Expeditions of 1936 and 1938 to New Guinea, contains many interesting novelties, some of which are here described.

The 1938 party made its base at Hollandia on the north coast of the island whence, using a large aeroplane, it established field bases on the Idenburg River and on Lake Habbema (3300 meters), on the northern slopes of Mt. Wilhelmina.

From Bernhard Camp (60 meters), the base on the Idenburg, subsidiary stations were occupied up the slopes to the crest of the range south of the river, the altitudes of which were recorded as 850, 1200, 1800, 100 meters, respectively.

From Lake Habbema two main lines of camps were prepared. One chain of stations reached downward, following the courses of the Bele and Balim Rivers (with drainage to the south coast of New Guinea)—through altitudes of 2800, 2200 and 1600 meters. A second series of stations passed to the eastern side of Mt. Wilhelmina and then drove upward to collecting stations at 3560 and 3800 meters. Thus the entire northeastern fall from Mt. Wilhelmina was ransacked for species at all elevations between 60 and 4000 meters.

The new forms come chiefly from the heavy lowland forests of the Idenburg River where they seem to have been rare and are represented often by single specimens; and from the high country above 2000 meters, in which case large series are available for study.

The 1936 expedition¹ placed its headquarters on the Island of Daru near the

mouth of the Fly River. Thence stations were established all the way up the Fly River and into the Central Mountain range to an altitude of nearly 1000 meters. Work was done also along the south coast of the Western Division of Papua at Mabadauan and Strachan Island, and in the Central Division northeast of Port Moresby up to Kagi, 1600 meters.

The mammals brought back by the 1938 Expedition were collected by W. B. Richardson; those of the 1936 Expedition by G. H. H. Tate. Both Richardson and Tate employed native collectors to help them. Measurements, unless otherwise stated, were taken by Richardson or Tate.

Colors printed with capitals are those of Ridgway.²

PARALEPTOMYS, NEW GENUS

This genus needs comparison only with *Leptomys*, from which it is separated by its normal hind foot (elongated in *Leptomys*), and by the absence of m_3^2 .

GENOTYPE.—*Paraleptomys wilhelmina*.

Paraleptomys wilhelmina, new species

TYPE.—No. 150512, Amer. Mus. Nat. Hist.; adult ♂; 9 kilometers NE. of Lake Habbema, near Mt. Wilhelmina, Netherlands New Guinea; altitude 2800 meters; October 15, 1938; collector, W. B. Richardson (field No. 5143), 1938 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—Superficially very like certain brownish-gray mountain inhabiting *Melanomys*. Differs sharply from *Leptomys* (with elongate feet and pure white ventral hairs), from *Pseudohydromys* (shrew-like), and from *Microhydromys* (Mus-like).

DESCRIPTION OF TYPE.—Skin dorsally colored near Bone Brown, very slightly intensified along the back; ventrally dull white, with gray bases

¹ For full report see Rand, A. L., and L. J. Brass, 1940, Bull. Amer. Mus. Nat. Hist., LXXVII, No. 29, pp. 341-380.

² Ridgway, 1912. Color Standards and Nomenclature.

which amply show through the white tips. Ears large, gray; hands and feet thinly covered with whitish hairs. Tail light fuscous above, white beneath, its terminal 1.5 cm. white. Tail-scales simple, flat, rounded to slightly hexagonal, 14 per cm. Scale-hairs 3 per scale, about one scale-length, whitish. Skull: in many respects very like *Leptomys*; rostrum, braincase, zygomatic plate, palate, pterygoid region and bullae are essentially the same. Differs in the absence of m_2^2 (reduced but still 3-rooted in *Leptomys*), and the diminution of flare of the maxillary root of the zygoma.

MEASUREMENTS OF TYPE.—Skin: total length, 261 mm.; tail, 135; hind foot (s.u.), 31; ear from crown, 17. Skull: condylo-incisive length, 29.2; zygomatic breadth, 16.0; length of nasals, 12; interorbital breadth, 5.7; breadth of interparietal, 7.3; breadth of braincase, 13.5; height of muzzle at level of front of incisive foramina, 5.8; palatal length, 14.5; palatal foramina, 4.8×2.3 ; diastema, 7.6; breadth between m_1^{-1} , 2.9; breadth of mesopterygoid fossa, 2.1; bulla, 4.9×3.6 ; width between bullae, 4.0; mastoid width, 12.2. Teeth: length $m_1 + m_2$, 4.5; m_1 , 3.0×1.8 ; m_2 , 1.6×1.5 ; $m_1 + m_2$, 4.6; m_1 , 2.7; m_2 , 1.8.

Assumption by m_2^2 of the terminal position in the tooththrow has so modified its form that the postero-external tubercle has been eliminated. In *Paraleptomys m_1* differs from that of *Leptomys* in being slightly broader. But a more important difference is observed in the relatively great depth of the fissures separating the three laminae of m_1^2 , seen from the outer face of the tooth. Said fissures reach a depth of 0.5 mm.—virtually to the level of the cingulum. In *Leptomys* the fissures either do not develop at all or remain minute (0.2).

Paraleptomys wilhelmina is represented in the collection obtained by Mr. Richardson by almost 50 specimens, all from the Lake Habbema region between 2200 and 3000 meters. A second series of 30 specimens from camps on the heights (1800–2100 meters) SW. of Bernhard Camp between the Idenburg River and its affluent, the Hablifoert River, may be separable as a faintly differentiated race. This slight difference is inconstantly manifested by the form of the anterior margin of the zygomatic plate; less excised in the Idenburg animals, more excised in the Habbema race. The two areas of distribution are made continuous by way of the highlands

connecting the Doorman Top ranges with the Wilhelmina uplands.

MICROHYDROMYS, NEW GENUS

The smallest known Hydromyine, and unique in possessing grooved upper incisor teeth. Pelage, ears, tail and lips without modifications for aquatic habitus. Feet neither modified for swimming nor elongate as in *Leptomys*. Skull exhibiting the short, broad muzzle and widened interorbital region and braincase of *Parahydromys*, but the bullae, although low, are very much larger and proportionally much closer together (width of bullae, 2.9; distance apart of bullae, 2.0); zygomatic plate essentially as *Hydromys* and *Pseudohydromys*; palatal foramina more as in *Leptomys*, less shortened than in *Hydromys*; nasals unshortened.

TEETH.—Upper incisors with distinct groove separating anterior face of tooth into an outer third and an inner two-thirds. Molars reduced to two in each row, as in most Hydromyinae, but the tooththrows wider spaced in the palate and less convergent anteriorly than in *Parahydromys* and *Hydromys*, the arrangement being essentially that of *Pseudohydromys*.

GENOTYPE.—*Microhydromys richardsoni*.

Microhydromys richardsoni, new species

TYPE.—No. 152079, Amer. Mus. Nat. Hist.; adult ♂; 4 kilometers SW. of Bernhard Camp, Idenburg River, Netherlands New Guinea; altitude 850 meters; March 16, 1939; collector, W. B. Richardson (field No. 7677), 1938 New Guinea Expedition. The type is a skin in good condition, and skull with braincase badly broken.

GENERAL CHARACTERS.—A blackish murid about the size of a housemouse, externally unspecialized; with terminal centimeter of tail white.

DESCRIPTION.—Skin: pelage dorsally deep fuscous, the hairs quite short (5 mm.), ventrally very slightly lighter and hairs slightly shorter. Ears neither reduced nor enlarged, gray. Feet and hands slender, thinly clad with short blackish hairs. Feet unwebbed and the soles lacking the granular structure of *Parahydromys* and *Hydromys*. Tail blackish above and below, the terminal cm. white. Scales rectangular; per cm. 15. Scale-hairs fine, short, blackish, about $1\frac{1}{2}$ scale-lengths. Skull: short and broad, with the general appearance of a tiny *Parahydromys* skull. Muzzle short and heavy; nasals unshortened (but slightly exceeded by pmx.); interorbital width unconstricted, attaining half of zygomatic width; braincase broad and full (broken); zygomatic plate excised in front (as in most Hydromyinae); palate about as broad as *Pseudohydromys* (its posterior part missing), and palatal foramina larger than in *Hydromys*, their length 50 per cent of diastema; bullae larger in proportion than in any other known Hydromyine genus, width of bulla more than one-third of combined width across bullae and included basioccipital.

MEASUREMENTS.—Skin: total length, 172 mm.; tail, 92; hind foot (s.u.), 20; ear from crown, 8. Skull: length of nasals, 6.4; width of nasals anteriorly, 2.6; width muzzle just anterior to zygomatic plate, 4.2; least interorbital width, 4.4; mastoid width, 9; approximate zygomatic width, 9.2; palatal length, approximately 10; palatal foramina, 2.5×1.5 ; diastema, 5; bullae, 3.8×2.9 ; distance apart of bullae, 2; distance between m^{1-1} , 2.3; length $m^1 + m^2$, 2.4; m^1 , 1.65×0.8 ; m^2 , 0.8×0.75 .

The discovery of this interesting "water rat" and of the allied form whose descriptions follow, supports the already established view that New Guinea has been an important focus of development for the Hydromyinae.

The species name commemorates the fine work done for the New Guinea Expedition by its discoverer, Mr. W. B. Richardson.

Microhydromys richardsoni is founded upon a single specimen.

Hydromys habbema, new species

TYPE.—No. 110055, Amer. Mus. Nat. Hist.; adult ♂; Lake Habbema, 15 kilometers north of Mt. Wilhelm, Netherlands New Guinea; altitude 3225 meters; August 18, 1938; collector, W. B. Richardson (field No. 4722), 1938 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—The smallest known *Hydromys* (s.s.); hind foot not exceeding 40 mm.; while in all others 50 mm. is passed. (*Parahydromys* and *Crossomys* both attain 50 mm.). Pelage gray with silvery tips, underparts pale gray, feet and hands whitish, terminal third of tail, white. Ears small, partly hidden by fur, but not extremely reduced as in *Crossomys*.

DESCRIPTION.—Pelage of back dense, soft, of aquatic type, about 12 mm., its color Deep Mouse Gray, the tips silvery. The weak guard hairs black. No trace of the rich brown colors seen in large *Hydromys*. Underparts soft and dense, near Smoke Gray, the bases rather darker, approaching Mouse Gray. Feet and hands with very short, silvery hairs. Tail fuscous above and below, its terminal half white. Scale-hairs about three scale-lengths, increasing markedly toward the tips (as in all *Hydromys*). Ears gray, partly concealed in pelt. Skull: small and delicately built, but with all the structural characteristics of *Hydromys*. Compared with *H. chrysogaster* subspecies, that of the new species has the muzzle slightly more slender and tapered anteriorly (as in *Crossomys*), and the braincase fuller and more nearly as wide as the zygomatic expanse. The supraoccipital region is also fuller and less rugose. The pterygoids are very low, particularly at their anterior end, so that the ectopterygoid recesses have become virtually obsolete. In the palate

the toothrows are somewhat more widely spaced, the width between m^{1-1} being rather more than twice the width of m^1 . Also the palatal foramina are slightly less shortened, remaining nearly 50 per cent of diastema.

MEASUREMENTS.—Skin: total length, 317 mm.; tail, 170; hind foot, 36; ear (s.u.), 9.1. Skull: condylo-incisive length, 33.3; zygomatic width, 17.4; least interorbital width, 5.6; width of braincase, 15.6; length of nasals, 11.2; palatal length, 17.8; diastema, 8; palatal foramina, 4.2×2.1 ; width between m^{1-1} , 4; width mesopterygoid fossa, 2.2; bulla, 4×3.4 ; width between bullae, 5.

The species is represented in Richardson's collection by twenty-five specimens from Lake Habbema (3225 meters) and four from a camp on the NE. slope of Mt. Wilhelm (3560–3600 meters).

Hydromys habbema represents a new type of *Hydromys*—a very small, delicate form which in no way approaches known *Hydromys*. It seems to be the least specialized of any species, and perhaps lies near the base of that stem from which came the highly specialized *Crossomys* and *Parahydromys* and the less specialized *H. chrysogaster* and *H. neobritannicus*.²

XENUROMYS,³ NEW GENUS

A new genus of "giant rats." Dentition approximates that of *Uromys*, but toothrows widely spaced in the palate and palatal foramina much larger. Audital bullae quite small as in *Uromys* and *Macruromys*. Zygomatic plate as broad and as well thrown forward but slopes more than in *Uromys*, and is unlike the straight to slightly excavated plate of *Macruromys*. The mandible of this rat differs in its weak development of the insertion of the masseter. In adult *Uromys* and *Rattus dominator* the masseteric ridge develops a prominent masseteric tubercle.

The teeth of *Xenuromys* besides resembling those of *Uromys*, recall those of certain *Rattus*, especially the *R. dominator* group of Celebes. But from *Rattus* they differ, as in *Uromys*, by the relative simplicity of the laminae of the molars. In m^1 and m^2 the third loph is proportionately much thickened from front to back (also a *Uromys* character); and correspondingly in the lower molars the anterior loph of m_1 is much reduced, while its posterior median tubercle (in *Rattus dominator* resting in an enamel bay behind loph 3) is expanded in *Xenuromys* and to a less degree in *Uromys* to form a considerable functional feature. The posterior

¹ Note.—In 1937 I remeasured the external ear of *Crossomys* while in London: the height from crown equalled 1 mm.

² I do not concur with Rümmler's (Mitt. Zool. Mus. Berlin, XXIII, 1, pp. 15–17) synonymizing of *Parahydromys* and *Crossomys*.

³ From ξένος, strange; *Uromys*, a genus of rats.

portion of m_2 shows a corresponding modification.

The relationships of this interesting new rodent may be considered to be with *Uromys* and *Rattus*, possibly near the point where the *Rattus* and *Uromys* stems diverged from each other, but after the development of *Uromys*-like dentition.

The enlarged palatal openings, broad palate and rather full braincase may be subsequent modifications analogous to those observable in *Macruromys*, from which in dentition it differs sharply.

GENOTYPE.—*Xenuromys guba*.

Xenuromys guba,¹ new species

TYPE.—No. 152043, Amer. Mus. Nat. Hist.; adult ♂; Bernhard Camp, Idenburg River, Netherlands New Guinea; altitude 75 meters; April 14, 1939; collector, W. B. Richardson (field No. 7847), 1938 New Guinea Expedition. The type is a skin with skull, the latter with rostrum broken, the former cut over the shoulder by the snare or trap.

GENERAL CHARACTERS.—Superficially like a large gray *Uromys* with pure white underparts, the tail coarsely scaled much as in *Hyomys*, but the un-keeled scales in annular instead of spiral arrangement.

DESCRIPTION.—Skin with short, crisp pelage in which the guard hairs are few, short and little differentiated. Dorsal color grizzled gray—the hairs dark gray with whitish tips, guard hairs black; ventrally white to the roots, with tint of light cinnamon under neck and throat. Feet and hands so thinly haired as to appear naked, white. Tail with basal half fuscous, terminal half white. Tail-scales rectangular or with the terminal margin slightly bowed, toward the distal part of tail becoming narrower and more wedge-shaped; scale-hairs per scale, the median one obsolete, white, about one scale-length. Ears small but not concealed in fur, naked, fuscous. Vibrissae very long as in *Mallomys* or *Hyomys*. Skull: rather less massively built than that of *Uromys*, with ampler muzzle and braincase, the latter approaching the fullness of the braincase in *Macruromys major*. Zygomatic not much expanded; small supraorbital ridges developed; skull lacking the pronounced bend in profile to be seen in the naso-frontal area of *Uromys*; palatal foramina large; palate broad; mesopterygoid fossa broad, the ectopterygoid wings unconnected with the alisphenoid at their outer, posterior tips; bullae quite small as in *Uromys*.

TEETH.—Upper incisors heavy, deeply pigmented, slightly opisthodont. Molars about as heavy as in lowland *Uromys* with the posterior loph in m^1 and m^2 enlarged, as indicated. Upper first molar proportionately narrower. The toothrows parallel and so widely spaced that the

width of m^1 is less than half of the width between m^{1-1} .

In the lower teeth the first lamina of m_1 is much reduced (as in *Uromys*, but not in *Rattus*) and the posterior tubercle of the same tooth, which lies in a median position behind the third lamina, is correspondingly enlarged and broadened. The same condition is seen with respect to the posterior tubercle of m_2 . In both teeth in *Xenuromys* the tubercles when slightly worn present a large triangular pattern. In *Uromys* the pattern is that of a narrow ellipse whose long axis runs transversely across the tooth. While in *Rattus* the tubercle, though an ellipse placed as in *Uromys*, is less accentuated.

MEASUREMENTS.—Skin: total length, 591 mm.; tail, 281; hind foot (s.u.), 66; ear from crown, 25. Skull: condylo-incisive length, 62.2; zygomatic breadth, 29.0; least interorbital breadth, 9.9; breadth of braincase, 22.8; breadth of interparietal, 12.5; mastoid width, 21.2; zygomatic plate, 7.6; palatal length, 35.0; zygoma, 20.4; palatal foramina, 9.3×5.3 ; width between m^{1-1} , 7.6; width pterygoid fossa, 6.5; bulla, 6×3.5 ; width between bullae, 10.1; length m^{1-1} , 11.8; m^1 , 5.7×3.3 ; m^2 , 3.8×3.0 ; m^3 , 2.2×2.1 ; m_1 , 11.0; m_1 , 4.7×3.3 ; m_2 , 3.7×3.1 ; m_2 , 2.7×2.4 .

Xenuromys guba is described from a single specimen caught by Mr. Richardson's native helpers in the heavy forest of the lowlands about the Idenburg River. The shattered state of the rostrum suggests it may have been killed by a blow with a stick while alive in a snare.

Lorentzimys nouhuysii alticola, new subspecies

TYPE.—No. 150592, Amer. Mus. Nat. Hist.; adult ♂; 9 kilometers NE. of Lake Habbema, Mt. Wilhelm, Netherlands New Guinea; altitude, 2700 meters; October 28, 1938; collector, W. B. Richardson (field No. 5261), 1938 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—A mountain inhabiting form, distinguished from the lowlands *L. n. nouhuysii* by the less extreme narrowing of the ear conch to the peculiar wedge-shape of the typical form (Jentink described them as "pointed, Vespertilio-like"); by the much longer, lax pelage (Jentink wrote "the longest hair does not exceed 6 mm."); by the gray instead of whitish cheeks; by the scale-hairs of the tail being black instead of white.

DESCRIPTION OF TYPE.—Color of back darker than in typical form; Mars Brown, as opposed to between Tawny and Russet—and much darker on neck and head where it approaches Bone Brown. Underparts grayish white, with fuscous bases. The dorsal pelage, 7-8 cm.; ventral pelage, 7-8 cm. Ears naked; light

¹ The aeroplane, by means of which the 1938 Expedition was transported to Lake Habbema, was named "Guba." The word in Motuan dialect means storm.

brownish fuscous. Hands and feet with short blackish hairs. Tail dark above, white beneath, its scale-hairs whitish (scale-hairs black in typical form). The distal half of the posterior margin of ear not excised, the tip of the pinna thus far more obtuse than in *L. n. nouhuysii*.

Skull very similar to that of lowland form, but with slightly longer, narrower muzzle. Palate with rather prominent, rounded ridges extending from m^{1-1} to the incisors along outside of palatal foramina. Nasals considerably narrower both in front and behind. That portion of maxilla anterior to the infraorbital canal nearly flat in new race, markedly inflated in typical form.

MEASUREMENTS OF TYPE.—Skin: total length, 211 mm.; tail, 128; hind foot (s.u.), 26; ear from crown, 19. Skull: condylo-basal length, 21.9; zygomatic breadth, 12.5; interorbital width, 5.6; breadth braincase, 11.0; mastoid width, 10.2; width of interparietal, 8.2; palatal length, 11.8; diastema, 5.9; zygomatic plate, 1.85; palatal foramina, 2.6×1.4 ; breadth between m^{1-1} , 2.6; mesopterygoid fossa, 1.0; bulla, 3.4×2.6 ; width between bullae, 4.1; molars, m^{1-2} , 2.8; m^1 , 1.4×0.9 ; m^2 , 0.9×0.9 ; m^3 , 0.6×0.7 .

Besides the type specimen of this race, Richardson found three paratypes, three additional specimens from the Bele River (2200 meters), 10–15 miles NE. of the type locality, and seven others from the camps on the ridge just south of the Idenburg River at altitudes between 1500 and 1800 meters.

To this race I refer a specimen (No. 108454) which I trapped at Kagi (1600 meters) on the Kokoda Road, Papua, in March, 1937, and tentatively the two animals collected in the Astrolabe Mountains, which Rümmler¹ referred to the lowland form.

In our collections we have two specimens which I believe referable to true *nouhuysii*: No. 105036, a female from the upper Fly River, altitude 80 meters, and No. 152087, a young male from near Bernhard Camp, Idenburg River, 850 meters. Both have the clear cinnamon-colored, short pelage mentioned by Jentinck. Ears and face (damaged by trap) cannot be studied in the Idenburg specimen. But in the Fly River animal the cheeks are white and the ears extraordinarily narrowed and wedge-shaped, the angle formed by anterior and posterior margins only slightly exceeding 45°. Unfortunately the skull of the Iden-

burg specimen is in fragments, but that of the mouse from the Fly River, though the braincase is much broken, has the rostrum complete and the palate nearly so.

From that specimen I determined the mammary formula in the field, namely: 1-2 = 6. The specimen contained two embryos.

POGONOMELOMYS RÜMMLER

Pogonomelomys RÜMMLER, 1936, Zeits. f. Säugetierk., XI, p. 252.

"*Melomys* with 3-haired tailscales" TATE, 1936, Bull. Amer. Mus. Nat. Hist., LXXII, p. 592.

Pogonomelomys RÜMMLER, 1938, Mitt. Zool. Mus. Berlin, XXIII, heft 1, pp. 99, 166.

When studying *Melomys mayeri*, the genotype of *Pogonomelomys* designated by Rümmler, neither he nor I wrote of the significant modification of the terminal 3 cm. = of the skin of the dorsal surface of the tail (though his use of the term *Pogonomelomys* suggests he suspected it). The presence of an additional specimen in Richardson's collection, plus his notes on the manner of prehension with the tail in the case of a further species described beyond, whose actions while alive were watched by Richardson, has brought this character sharply to my attention.

In both the new specimen of *mayeri* (No. 152364) from the Idenburg River at 400 meters and in the co-types collected by Shaw Mayer in the Weyland range at 1600 meters this caudal modification is expressed through replacement of the large, obvious scales by a nearly smooth, less pigmented tactile surface. This new character, namely, the ability to flex the tip of the tail dorsally and probably to use it for prehension, added to those already set forth by Rümmler and myself as distinguishing *M. mayeri* from *Melomys* (s.s.), warrants in my opinion full generic separation of *Pogonomelomys*. The great difference between the dentitions of *Pogonomys* and *Pogonomelomys* seems to insist that the development of such peculiar type of caudal prehension has come about independently. *Pogonomelomys* must be regarded as a highly specialized offshoot of the stock from which *Melomys*, *Xenuromys* and *Uromys* have risen.

¹ Rümmler, 1938, Mitt. Zool. Mus., Berlin, XXIII, heft 1, p. 57.

At Genoa in 1937, with the kind permission of Dr. de Beaux I studied the type of *bruijnii*. That animal, a female from Salawatti is very large, far exceeding in size *mayeri* and a new form from the Fly River whose description follows.

Rümmler included, with the climbing *bruijnii* and *mayeri*, two smaller, terrestrial-footed species, *sevia* from Huon Peninsula and *fraterculus* from Ceram. It is questionable whether they ought now to be included; *sevia* at least, of which Richardson took three closely related specimens at Lake Habbema, has no trace of specialized tail structure. But a large series of another small species having prehensile tail and scampering feet is tentatively referred to *Pogonomelomys*.

Pogonomelomys bruijnii brassi, new subspecies

TYPE.—No. 105033, Amer. Mus. Nat. Hist.; adult ♂; Oroville Camp, Upper Fly River, 30 miles above d'Albertis Junction; altitude 60 meters; collector, G. H. H. Tate, 1936 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—A large brownish-gray rat with large tail-scales, scandent, large-clawed feet and dorsally prehensile tip to tail. It was present with true *Pogonomys mollipilosus* and in the field was confused with it.

DESCRIPTION.—Dorsal pelage slightly crisp, not short, essentially as in *mayeri*, the color grayer, less rufous; ventral color white to the base as in *bruijnii* and *mayeri*; ears fuscous; both hands and feet whitish, a narrow brown streak extending down the back of foot to between bases of 3rd and 4th digits; tail longer than body, fuscous above and below, with distinctive dorsally prehensile tip; tail-scales large, hexagonal, 9 per cm.; scale-hairs 3 per scale, about 1/3 scale-length, becoming near tip 2/3 of scale-length; ears small. Skull, massive, well arched in profile, with the well-developed supra-orbital ridges, general palatal and dental structure and the full, rounded bullae of *bruijnii* and *mayeri*. It diverges from *bruijnii* chiefly by its much smaller size, and from *mayeri* by being decidedly larger, particularly in the enlargement of the bulla and the development of a strong posterior palatal spine.

MEASUREMENTS.—Skin: total length, 370 mm.; tail, 197; hind foot (s.u.), 33. Skull: condylo-incisive length, 37.5 (—; 34.0); zygomatic width, 20.4 (23.4; 19.9); interorbital width, 6.7 (7.2; 5.9); breadth of braincase, 15.4 (17.4; 15.0); diastema, 11.0 (12.7; 9.4); palatal

length, 20.2 (22.6; 17.7); length palatal foramina, 5.1 (5.1; 5.2); breadth mesopterygoid fossa, 3.3 (3.5; 3.1); bulla, length, 5.8 (—; 4.7); m_1^{-1} , 7.1 (8.1; 6.5); width m_1 , 1.9 (1.95; 1.75).

P. b. brassi is based upon the type and a part-grown female topotype without skull. The close kinship of *bruijnii*, *mayeri* and *brassi* is emphasized here. They are large *Melomys*-toothed rats with broad feet, very large claws and dorsally prehensile tails.

The new form is named for Mr. L. J. Brass, the botanist who accompanied all three of the Archbold Expeditions to New Guinea.

Pogonomelomys rümmleri, new species

TYPE.—No. 150669, Amer. Mus. Nat. Hist.; young adult ♂; Lake Habbema, north slope of Mt. Wilhelm, Netherlands New Guinea, altitude 3225 meters; July 26, 1938; collector; W. B. Richardson (field No. 4523), 1938 New Guinea Expedition. The type is a skin with skull, in good condition.

GENERAL CHARACTERS.—A small dark brown rat with *Melomys*-like dentition, feet unmodified for climbing (compare *P. mayeri*) but with dorsal 3 cm. of tail provided with tactile surface for prehension.

DESCRIPTION.—Skin with rather long fur (12 mm.), colored above near Bone Brown, becoming Clove Brown along the back, the face with a grayish cast; underparts grayish white, the long pelage with fuscous bases which show through. Hands and feet clothed with light yellow-brown hairs. Ears fuscous. Tail brown; the scales small and lacking the prominent keeled structure of true *Melomys*, their scale-hairs blackish, 3 per scale and from 2 to 3 scale-lengths (compare *P. mayeri*). Skull much smaller than that of *P. mayeri*, the rostrum much compressed and less shortened; supraorbital ridges undeveloped; braincase fuller; zygomatic plate much narrower, and nearly straight as in *Macruromys*; palate with elongate anterior foramina and quite large posterior foramina; back of palate even with back of m_2 ; bullae small; angular process of mandible quite short. Incisors narrow, unbroadened, orange. Molars very small and of characteristically simple *Melomys* type.

MEASUREMENTS.—Skin: total length, 242 mm.; tail, 138; hind foot, 25; ear from crown, 17. Skull: condylo-incisive length, 26.1; zygomatic width, 16.2; nasals, 10.3×2.8 ; interorbital width, 4.5; width of braincase, 14.0; interparietal, 10.5; mastoid width, 10.8; zygomatic plate, 2.7; palatal length, 13.9; diastema, 7.3; palatal foramina, 6.0×2.1 ; mesopterygoid fossa (taken between pterygoids), 1.9; bulla, 4.2×3.1 ; distance apart of bullae, 3.6; m_1^{-1} , 4.4; m_1 , 2.0×1.4 .

¹ Measurements of type of *bruijnii* and of co-type (No. 101954) of *mayeri* follow in parentheses.

Pogonomelomys rümmleri is founded upon an exceptionally fine series of thirty specimens from the type locality and fifteen more from Wilhelmina Top, 300 meters higher. Many of the old specimens show a distinct tawny wash over the tips of the ventral hairs. Adult specimens not necessarily old also show great wear of the molars, probably accountable by conditions of soil and vegetation in their habitats.

PLANIGALE TROUGHTON

Planigale TROUGHTON, 1928, Records Australian Mus., XVI, p. 282.

Wood Jones¹ drew attention to many characters of the Australian Phascogalinae, among then distinguishing between "*Phascogale*" (*Phascogale* and *Antechinus*) and *Sminthopsis*. His illustrations particularly showed characters of *P. flavipes*, type of *Antechinus* and of *S. crassicaudata*, type of *Sminthopsis*, comparing the short foot with striated pads of the former with the slender foot with granulated pads of the latter. In the skulls he noted distinctions in the interorbital area and the nasals.

Iredale and Troughton² have separated *Phascogale* Temminck and *Antechinus* Macleay. The former contains only the brush-tailed *tapoatafa* (the genotype) and *calura*, in both of which the bulla is relatively greatly enlarged and the periotic is also inflated. Thus *Antechinus* contains generalized forms while species referable to *Phascogale* (s.s.) and *Sminthopsis* show specializations.

The majority of the Phascogalinae from New Guinea have striated pads, rather short feet, small bullae and moderately broad interorbital region, thus fitting in with *Antechinus* and *Phascogale* rather than with *Sminthopsis*.

The tooth succession in the "phasco-gales" is an important feature which must be understood when working upon their classification. Usually material for study of this process is lacking but in the case of *Antechinus melanura* several young specimens in our collection demonstrate it perfectly:

American Museum numbers 109794 ♀ and 105854 ♀: incisors, canines, p_1^1 , p_2^3 , m_{1-3}^{1-3} are fully in place; p_4^4 changing (several of the four minute milk premolars still in place and the tips of the permanent set plainly visible); m_{4-6} virtually in place, but m^4 only half erupted.

American Museum numbers 105795 ♂, 152034 ♀, and 108562 ♀ (younger): the minute, 2-rooted milk p_4^4 undisturbed, m_3^3 half erupted; m_4^4 undeveloped. In this specimen milk p_4 is vestigial and single-rooted, and remains, like certain bats' teeth excluded at the outer margin of the toothrow.

These dental changes take place at a very early age—when the animal has reached only about one-half of its adult weight.

The vestigial condition of the milk p_4^4 , especially of the single-rooted tooth of the lower jaw may account for Lönnberg's belief that the absence of the "lower secator" of his *Phascogale subtilissima* (a *Planigale*) is a generic character. On the other hand, photographs of the skull of his type in my possession show the upper permanent fourth premolar to be large and completely erupted, though unworn. So permanent p_4 of his species may really never develop.

It has yet to be shown that the tooth succession indicated for *melanura* prevails among other species. Nevertheless, minute, obsolescent, or seemingly obsolete fourth premolars should be viewed with suspicion. For normally, in adult animals p_4^4 are the largest or next to largest of the premolars.

Planigale appears to be related to *Antechinus* but differs by its much flattened, widened skull; short, wide palate and rostrum; heavy feet, with pads faintly striated.³

The form described beyond had the skull markedly flattened. Unfortunately, by some accident the entire braincase behind the broad interorbital region has been broken and destroyed, and specific characters can be based only upon what remains and upon skin characters.

Planigale novaeguineae, new species

TYPE.—No. 108561, Amer. Mus. Nat. Hist.: adult ♂; Rona Falls, near Port Moresby, Cen-

¹ Wood Jones, 1923, The Mammals of South Australia, pp. 94-122.

² 1924, A check list of the mammals recorded from Australia, p. 7.

³ Troughton describes the pads of *P. i. brunneus* as granulated, "the granulations comparatively large." I found faint striations, not granulations.

tral Division, Papua; altitude 250 meters; Jan. 20, 1937; collector, G. H. H. Tate, 1936 New Guinea Expedition. The type is a skin in good condition and skull with posterior half missing.

GENERAL CHARACTERS.—A small brownish-gray marsupial mouse, with very low ears deeply notched at their posterior margins; heavy short feet; and tail shorter than head plus body.

DESCRIPTION.—Skin: dorsal color brownish gray, formed by a mixture of short, light brown, black-tipped hairs and inconspicuous black guard hairs; ventral color light tan, gray-based, except chest and throat where the hairs are light brown to bases. Hairs of scrotum vinaceous; of hands and feet pale brown; those of tail fuscous above, light brown beneath. Ears peculiar, very low, projecting 7 mm. above crown, but rather ample posteriorly, the opening from meatus to outer pinna very high (7 mm.). (Note that the ears shown by Troughton, plate 39, have been revolved. Their vertical height parallels a diagonal line from upper left to lower right across the page.) The posterior margin of the pinna in *novaequineae* is deeply notched. Ear finely haired internally and externally. Faint traces of striations on pads (rest of foot normally granulated as in *Antechinus* and other genera). Skull: when newly caught the specimen had the braincase extremely flat and low. Destruction of the braincase precludes demonstration of that fact. Rostrum heavy, broad and flat extending backward to broad interorbital region; nasals twice as broad proximally as distally, without notch between them at tips (as in *Antechinus flavipes*); palate much broken, its incisive foramina reaching back only to middle of canine alveoli (posterior vacuities destroyed).

Incisors: i^{1-1} twice the size of other incisors, not contiguous; i^{3-4} subequal, slightly larger than i^2 ; lower incisors absent (alveoli only). Canines straight, slender. Premolars: appearing crowded, becoming successively and sharply larger from p^1 to p^3 to p^4 , all with high triangular blades and 2-rooted; each lower premolar with a "heel," especially well developed in p_3 ; p_1 absent (2-rooted) but unquestionably larger than reduced p_4 , and much smaller than p_3 ; p_4 though very small and single-rooted, is apparently a permanent tooth, not to be confused with the minute milk p_4 of the deciduous dentition (m_4^2 completely in place).

MEASUREMENTS.—Skin: total length, 170 mm.; tail, 78; hind foot (s.u.), 14; ear from crown, 7. Skull: nasals, 9.3×4.1 ; interorbital width, 6.1; anterior palatal foramina, 1.8×1.5 ; length toothrow, 10.8; m^{1-2} , 4.3; crown of m^1 , 1.7×1.2 ; m^2 , 1.4×1.6 ; m^3 , 0.75×1.7 .

Intensive trapping about the great rock-strewn slope where this animal was caught failed to produce any more. It was taken in a dryish place beneath an overhanging

rock. The hillside was comparatively barren of vegetation.

Planigale novaequineae is decidedly larger than any hitherto described (*ingrami*, *brunneus*, *tenuirostris* and *subtilissima*)—all from Australia.

Antechinus tafa centralis, new subspecies

TYPE.—No. 109823, Amer. Mus. Nat. Hist.; adult ♂; Bele River, 18 kilometers north of Lake Habbema, north of Mt. Wilhelmina, Netherlands New Guinea; altitude 2200 meters; Nov. 17, 1938; collector, W. B. Richardson, 1938 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—Separable from true *tafa* only by cranial characters described below.

DESCRIPTION.—Skin: above dark gray, with a glint of light brownish, grayer on head; beneath dull grayish white with gray bases; transition from dorsal to ventral color not well defined. Ears fuscous. Hands and feet with light gray hairs. Tail brownish gray, becoming yellowish gray beneath—the tip with slight hair pencil. Skull, distinguished from that of true *tafa* by the following characters: enlargement of the posterior palatal fenestrae; marked increase in internal width of the mesopterygoid fossa just behind palate.

MEASUREMENTS.¹—Skin: total length, 281 mm. (279); tail, 146 (145); hind foot (s.u.), 26 (24); ear from crown, 15 (17). Skull: condylo-incisive length, 34.3 (32.0); zygomatic width, 19.2 (17.1); least interorbital width, 7.8 (7.7); width braincase, 13.9 (13.4); palatal length, 18.0 (17.0); posterior palatal fenestrae, 4.0 (3.4); greatest inside width of mesopterygoid fossa, 4.5 (3.8); bulla, length, 3.9 (3.1); toothrow, i^{1-m^4} , 17.6 (17.3); m^{1-4} , 7.3 (7.5); m^{1-3} , 6.3 (6.3); width m^1 , 1.7 (1.7). The smaller size which shows throughout is due to the type of true *tafa* being a female. In a female (No. 109809) of *A. t. centralis* the width of the mesopterygoid fossa is 4.3, and the length of the fenestrae, 4.1.

The new race is represented by a total of 22 specimens from localities near Mt. Wilhelmina, varying from 1500 to 2800 meters.

Antechinus habbema, new species

TYPE.—No. 109812, Amer. Mus. Nat. Hist.; adult ♂; 9 kilometers NE. of Lake Habbema, north slope of Mt. Wilhelmina, Netherlands New Guinea; altitude, 2800 meters; collector, W. B. Richardson, 1938 New Guinea Expedition. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—Astoundingly like *A. tafa centralis*, whose upper distributional range it shares. Differing by the much smaller, more delicate feet and hands, and much smaller

¹ Measurements of *A. tafa tafa* are placed in parentheses.

teeth. Its nearest relative must nevertheless be regarded as *A. tafa*.

DESCRIPTION.—Skin: color and quality of pelage above and below almost exactly that of *A. tafa centralis*. Ears fuscous. Tail above as *A. t. centralis*, beneath darker, the hairs fuscous. Feet and hands much smaller and more delicately formed; the width of foot across base of 5th metatarsal, 3.7, in *A. t. centralis*, 5.1, and in the type of *A. t. tafa* (♀), 4.3. Skull: general character of *tafa* but smaller. Back of palate well behind m^{1-4} , and supplementary fenestrae appearing between the posterior palatal fenestrae and the back of palate. Teeth smaller, molars also narrower than in *tafa*.

MEASUREMENTS.—Skin: total length, 252 mm.; tail, 140; hind foot (s.u.), 21; ear from crown, 13. Skull: condylo-incisive length, 29.6; zygomatic breadth, 6.5; least interorbital width, 7.7; width of braincase, 13.0; palatal length, 15.7; posterior palatal foramina (primary), 3.9, (secondary) 0.8; width mesopterygoid fossa, 3.7; length bulla, 2.9; tooththrow, i^1-m^4 , 14.6; m^1-4 , 6.1; m^1-3 , 5.3; width m^1 , 1.4.

This species (it must be so considered) is founded upon five specimens. It was taken from 2200 to 2800 meters in the neighborhood of Lake Habbema.

Sminthopsis in South New Guinea

Thomas¹ described a species *rufigenis* from the Aru Islands which he compared with *S. virginiae* Tarragon from North Queensland. A few years ago I published a description² of *Phascogale rona* from

Rona, near the Laloki River, Central Division, Papua.

While working the savanna country of the middle Fly River at Lake Daviumbu a large series of more than 60 specimens of this interesting little marsupial was secured. Eight more were trapped at Tarara, Wassi Kussa. The big series at Daviumbu could be secured because of the interdigitation of tongues of low grass-savanna with swamps and flooded extensions of the lake. Burning of some of the grass areas resulted shortly in a high concentration of a previously well-dispersed mammal fauna among the unburned vegetation at the waterside.

In the summer of 1937 I was privileged to visit the British Museum (Natural History) and study among other types that of *rufigenis*. I was struck with the close relationship of my large series from Daviumbu to the types of *rufigenis* and *rona*. Further study establishes that all have nasals unwidened behind, narrow feet and pads distinctly granulated instead of striated, and are thus members of the genus *Sminthopsis*—atypical members it is true, since the tails do not become swollen.

Many of the females had young in the pouch. Mammary formula invariably 3 pairs = 6.

¹ Thomas, 1922, Ann. Mag. Nat. Hist., (9) IX, p. 265. 1922, Nova Guinea, XIII, pp. 739-740.

² Tate and Archbold, 1936, Amer. Mus. Novitates, No. 823, p. 2.

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RESULTS OF THE ARCHBOLD EXPEDITIONS: NO. 32

NEW AND INTERESTING BIRDS FROM NEW GUINEA

By A. L. RAND

This paper contains additional accounts of new and interesting birds discovered in working out the bird collections of the 1936-1937 expedition to south New Guinea and the 1938-1939 expedition to north New Guinea. Twenty new subspecies are described in this paper. I am indebted to Mr. James C. Greenway of the Museum of Comparative Zoology, Cambridge, and to Mr. Rodolphe de Schauensee of the Academy of Natural Sciences of Philadelphia for the loan of pertinent material.

Butorides striatus idenburgi, new subspecies

TYPE.—No. 305667, Amer. Mus. Nat. Hist.; ♂ ad.; Bernhard Camp, 50 meters altitude, Idenburg River, Netherland New Guinea; March 25, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—This is a pale form with little rufous color on the underparts and almost white edgings to the upper wing-coverts. From *moluccarum* it differs in having the throat unmarked white, not rufous gray and white; front of neck and upper breast mixed white and gray, with a few brownish streaks, not rufous gray heavily streaked with brownish and little white; breast and flanks pale gray with a faint rufous tinge, not darker gray distinctly rufous washed; abdomen pale buffy, white in some specimens, not gray, little different from the breast; edgings of upper wing-coverts buffy white, not pale ochraceous.

WING.—♂ ad. 181 mm., 185; ♀ ad. 175, 176, 176, 177, 181.

CULMEN.—♂ ad. 64 mm., 64, 67; ♀ ad. 63, 63, 63, 65, 66.

RANGE.—Known only from the type locality.

REMARKS.—The sexes are practically alike in this series and there is little individual variation. It is surprising how different this race is from the dark form *papuenis* which replaces it to the west.

Accipiter fasciatus dogwa, new subspecies

TYPE.—No. 421685, Amer. Mus. Nat. Hist.; ♂ ad.; Dogwa, Oriomo River, Territory of Papua, New Guinea; February 16, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—In the adult plumage, differs from *polycryptus* in the paler underparts, the dark bars being narrower and paler vinaceous brown, the white bars wider; and in the tendency toward reduction of the barring on the thighs, abdomen, under tail-coverts and under wing-coverts: from *hellmayri*, differs only slightly in the average heavier barring on the thighs, abdomen and under tail-coverts. In the immature plumage, differs from *polycryptus* in the slightly paler brown markings below; from *hellmayri*, differs in the very much paler, not dark brown, markings of the underparts.

WING.—♂ ad. 223 mm.; ♀ ad. 245, 255, 256; ♂ imm. 221, 225; ♀ imm. 240, 250, 250.

RANGE.—Known only from south New Guinea.

REMARKS.—Stresemann (1935, Orn. Monatsb., pp. 110, 111) has pointed out that two adult males from Merauke were very similar to Timor birds, and included them in *hellmayri*, while suggesting that the immature plumages might be different. The material compared includes *polycryptus* (SE. New Guinea) 7 ♂ ad., 2 ♂ imm., 2 ♀ ad., 2 ♀ imm.; *dogwa* (S. New Guinea) 4 ♂ ad., 2 ♂ imm., 3 ♀ ad., 3 ♀ imm.; *hellmayri* (Timor, Savu and Alor) 9 ♂ ad., 6 ♀ ad., 2 ♀ imm.

Circus spilonotus spilothorax Salvadori and D'Albertis

Lake Habbema: 1 ♀ ad.; August 11.
Balim River: 1 ♂ ad., 1 ♀ ad.; December 7, 14.

Found at 1600 and 3225 meters altitude.

WING.—♂ 378 mm.; ♀ 400, 405.

The December female had its ovary slightly enlarged.

The understanding of the status of the New Guinea *Circus* is unsatisfactory, due to lack of material. But what data and material I have accumulated suggest that New Guinea is inhabited by an endemic form of *Circus* in which the adult male assumes a silvery, black and white plumage. On Mt. Albert Edward in June, 1933, silvery males and light brown females were not uncommon. About Lake Daviumbu on the middle Fly River in August and September, 1936, silvery males and brown birds of various shades of darkness were fairly common. About Lake Habbema in August, 1938, gray, black and white males and light brown females were fairly common; few were seen along the Balim River in December, 1938. Though not uncommon in certain localities, these birds were always difficult to secure and besides the above three specimens I have only one other, an adult male, from Mt. Albert Edward (wing 441).

In size, the Balim River male and the type of *spilothorax* (wing 380, Salvadori, 1880, Ornith. Pap., p. 71) fall below the range of that of *spilonotus* (10 ♂ ad. 395-417, while Stresemann, 1924, Jour. für Orn., p. 28, gives ♂ 385-425) and the females fall below the average (*spilonotus* ♀ ad. 420, 420, 425, 428, 451; Stresemann, loc. cit., gives ♀ 400-440). However, the adult male from Albert Edward is much larger (wing 441). This may indicate different populations in New Guinea, a point only further material can settle.

In color, the Balim River male has the upperparts extensively black above, including the crown and most of the upper wing-coverts, but it is not as extensively black as one Philippine male which has the sides of the head black. Most of the males seen about Lake Habbema had much black in the mantle at least; this was not the case in the Fly River area nor on Mt. Albert Edward. On the underparts the Balim River male compares well with ten adult males of *spilonotus*. The Mt. Albert Edward bird, apparently fully adult, has the black feathers of the crown conspicuously edged with rusty, those of the hind neck with white, the mantle and lower back uniform brownish black, and

the streaking on the underparts dark brown instead of black and extending onto the abdomen, differing in this from *spilonotus*. Both specimens differ from the 10 adult *spilonotus* in having the spotted outer rectrices washed with rufous, a character mentioned for the type of *spilothorax*. Both specimens have dark subterminal spots in the central rectrices and the Albert Edward bird has an indication of these in some of the other rectrices, as occurs in the subadults of *spilonotus*, but there is no band as recorded for the type of *spilothorax*.

The two adult females are very similar to each other, and differ considerably from six adult female *spilonotus* in the paler underparts, lacking the rufous wash on the breast, having only a light rufous wash on the thighs and abdomen, and having the streaking narrower; on the upperparts they differ in almost entirely lacking the rufous wash which is pronounced in *spilonotus*.

Since Salvadori's time there have been few specimens of *Circus* recorded from New Guinea. Stresemann (op. cit., p. 263) has recorded an immature of this race from New Guinea in March and pointed out how it differed from the young of *spilonotus*; Mayr and Camras (1938, Zool. Series Field Mus. Nat. Hist., XX, p. 465) recorded a May juvenile from east New Guinea which they referred to *spilonotus*.

From the above data we have records of the marsh hawk in New Guinea in March, May, June, August, September, December. In the color of the outer tail-feathers of the two adult male specimens they differ from *spilonotus* and agree with the description of *spilothorax*. The two adult female specimens differ considerably in color from those of *spilonotus* available. On this evidence it seems advisable to consider these New Guinea specimens as representing an endemic race *spilothorax*.

Circus approximans gouldi Bonaparte

Lake Daviumbu: 1 ♀ imm.; September 8.

Found near sea level.

WING.—391 mm. +.

This specimen, with worn wing, is provisionally referred to this race. It is very

dark above and below, with the white basal edgings to the feathers of the hind neck showing.

The taking of this specimen in an area where gray and white examples of this genus, probably *C. spilonotus*, were seen in August and September is further evidence for keeping *spilonotus* and *approximans* as separate species.

Somewhat similar cases, in which a "New Guinea" form and an "Australian" form, usually considered geographical representatives, have been found together in south New Guinea are: *Aegotheles bennettii* and *cristatus*, *Eudynamis scolopacea* and *cyanocephala*, and *Dicrurus carbonarius* and *bracteatus*.

Capella hardwickii (Gray)

Mt. Wilhelm, 6 miles northeast: 1 ♂; August 27.

Found at 3550 meters altitude

WING.—161 mm.

Though this migrant from the palaearctic was known to winter in Australia, it has hitherto not been recorded for New Guinea.

Ducula spilorrhoa

In identifying birds of this species from south New Guinea it was immediately apparent that this species was divisible into four clearly marked races, instead of the two usually recognized. In the following I have reviewed the material in the American Museum and four specimens from Biak Island from the Academy of Natural Sciences of Philadelphia, which Mr. Rodolphe Meyer de Schauensee kindly loaned me.

Ducula spilorrhoa subflavescens (Finsch)

Carpophaga subflavescens FINSCH, 1886, Ibis, p. 2—extreme north corner of New Ireland.

This very distinct race is characterized by the general yellowish tinge to the white plumage; the great amount of black on the tip of the outer pair of tail-feathers, which varies between 15 and 36 mm. in width, measured along the shaft; the large size of the black spots in the under tail-coverts, which tend to be apical; the reduction in

the amount of black spotting in the lower flanks, the tendency for these markings to be on the ends of the feathers, and to form a solid black area: and the primary coverts beneath the alula being black, or mixed black and white.

WING MEASUREMENTS

	Male	Female
New Britain (sea level)	(10) 239–247 mm. (av. 243.6)	235, 236, 238, 239, 244, 247
(2500–3000 ft.)	250	247
New Ireland	241, 242, 249	236
New Hanover	(sex? 245, 254)	
Admiralty Islands	258	

SOFT PARTS.—Iris brown or dark brown; bill bluish or bluish slate, tip yellowish (in skins the distal third is yellowish); feet slate blue or lead blue.

RANGE.—The Bismarck Archipelago and Admiralty Islands; up to 3000 feet altitude.

REMARKS.—There is considerable variation in the intensity of the yellowish tinge in New Britain birds; this is not due to fading, as a series of seven collected in 1925 is yellower than a series of eleven collected in 1932–1933. New Ireland and New Hanover birds average paler yellow than New Britain birds, and are as pale as the palest of them. New Ireland birds that have been in museum cases since 1889 and 1893 are about as yellow as specimens collected in 1928. The Admiralty Islands bird is as yellow as the yellowest New Britain bird. It is interesting that in New Britain this species was taken inland at 2500 and 3000 feet altitude, and that these birds should be at the upper limit of the size variation for birds of that island.

MATERIAL.—Admiralty Islands (Manus), 1 ♂; New Hanover, 2 sex (?); New Ireland, 3 ♂, 1 ♀, 3 sex (?); New Britain (Talesia, Bainings, Tarobi, Balayang 2500 ft., Lobi 3000 ft.), 11 ♂, 7 ♀.

Ducula spilorrhoa spilorrhoa (Gray)

Carpophaga spilorrhoa G. R. GRAY, 1858, P.Z.S. London, pp. 186, 196—Aru Islands.

DIAGNOSIS.—Very different from *subflavescens* in the white or only palely yellow-tinged body plumage; in the primary coverts under the alula being white; in the much less black in the end of the outer

pair of tail-feathers, which varies between 0 and 12 mm. in width, measured along the shaft; the average smaller size of the black markings of the under tail-coverts, which tend to be subapical; in the black markings in the lower flank-feathers being subapical and more scattered to form an area of spotting.

WING MEASUREMENTS

	Male ad.	Female ad.
Aru Islands	245 mm.	237
Biak Island	227, 231, 231	233
Takar	230	
Jamna Island		232
Konstantinhafen	239	
Vulcan Island	242, 245	242
Dampier Island	253	242
Normanby and Fergusson Islands		242, 246
Trobriand Islands	229, 232, 237, 238, 244	239
Woodlark Island	231, 234, 235, 237, 244	(10) 225-237 (av. 231)
Misima Island		243
Rossel Island	240, 244, 244, 246, 247, 251	240
Sudest Island	241, 245	239
Grange Island	240	234

RANGE.—Apparently many scattered, isolated populations occur both on islands and the mainland of New Guinea: on the north coast east of Geelvink Bay; on the south coast east of Grange Island; Aru Islands, islands of Geelvink Bay, Dampier, Vulcan, D'Entrecasteaux, Woodlark, Trobriand, and Louisiade Islands.

REMARKS.—There is some variation in size in different populations, and birds from the eastern part of the range have on the average larger black markings on the under tail-coverts, but these differences are not great enough to be used in separating races. One Woodlark and one Rossel Island female, both apparently adult, have the plumage of the back tinged with gray, but not the head. An immature bird from Jobi (the only one I have from Jobi) has the upperparts tinged with gray and no black in the tips of the outer pair of tail-feathers, agreeing closely with an immature bird from the Aru Islands.

SOFT PARTS.—Ripley (1939, Proc. Acad. Nat. Sci. Phila., XCI, p. 18) pointed out that the Biak birds have the bill and feet bluish slate in contrast to the pale yellow-

greenish tint of these parts in mainland birds, so I made a survey of the soft parts of this series as recorded on the various labels.

LOCALITY	BILL	FEET
Aru Islands	Greenish yellow or greenish sulphurous	Ash gray or bright ash gray
Biak Island	Gray slate or bluish slate with greenish tip	Blue slate or pale blue slate
Takar	Slate blue, tip olive yellow	Slate blue
Jamna	Slate blue, tip horn	Slate blue
Vulcan and Dampier Islands	Slate blue and dull or greenish yellowish or dull greenish yellow and slate	Slate blue
Normanby and Fergusson Islands	Brown Green	Gray Gray
Woodlark Island	or bluish slate, yellowish at tip or yellow, gray at base	or gray slate or grayish lavender or lavender
Sudest Island	Yellow, tinged green or green slate or sage green	Blue slate or zinc blue
Rossel Island	Greenish yellow or greenish slate, yellowish tip or olive green or greenish yellow, slate base	Lead blue or zinc blue or dark slate blue

From this it appears that the birds with bluish bills are not restricted to Biak Island. Perhaps there is a seasonal change in this character.

Ducula spilorrhoa melvillensis
(Mathews)

Myristicivora bicolor melvillensis MATHEWS, 1912, Austr. Av. Rec. I, p. 27—Melville Island.

DIAGNOSIS.—Differs from *spilorrhoa* in having the head distinctly gray-tinged.

WING MEASUREMENTS

	Male ad.	Female ad.
Melville Island	234, 234, 230, 238 mm.	233 (type)
Northern Territory (Alligator, Daly, Mary rivers)	235, 236, 239	230, 232, 247, 247
Cape York	227, 232, 238, 239	223, 238
Central Queensland (Cooktown to Mackay)	228, 229, 229, 231, 232, 232, 235, 237, 240	236, 238
Lord Howe Island	241	
Nioura		235, 237

RANGE.—Northern and eastern Australia and the Hall Sound region of New Guinea.

REMARKS.—This is a fairly distinct race. The five birds from the type locality, Melville Island, show the characters clearly. Some of the other Northern Territory birds have a slight grayish tinge on the upperparts, and three have some dusky instead of white shafts in the tertials and wing-coverts. The two Nioura (New Guinea) birds are very like this. The Cape York birds are badly stained and dirty, but all have a rather distinct gray head and some have a faint grayish tinge on the back. The Central Queensland birds have whiter plumage, with little or no gray tinge in the back; some, including a Mackay bird, have a distinctly gray head, others have it barely indicated. The Lord Howe Island bird has a distinct gray head, a faintly gray-tinged back, and some of the tertials have dusky shafts.

***Ducula spilorrhoa tarara*, new subspecies**

TYPE.—No. 425391, Amer. Mus. Nat. Hist.; ♂ ad.; Tarara, Wassi Kussa River, Western Division, Territory of Papua, New Guinea; December 30, 1936; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differs from *melvillensis* in having the head deeper gray and the body plumage above and below gray-tinged, much more so than in any of the examples of *melvillensis* which are gray-tinged.

WING.—♂ ad. (10) 234–248 mm. (av. 239.9); ♀ ad. 226, 231, 236, 241, 242, 247.

RANGE.—South New Guinea, from the Fly River westward at least to Merauke.

REMARKS.—This is a very distinct race. There is considerable variation in this series; some are rather dark gray in general coloration, others pale gray, but none has the body plumage white, and none lacks the gray head. Some specimens have a slight yellowish tinge to the plumage. Some but not all have the tertials and wing-coverts with dusky colored shafts.

The grayness of south New Guinea birds has been remarked on a number of times (Siebers, 1930, Treubia, VII, Suppl., p. 186—Netherland south New Guinea, and Stresemann and Paludan, 1935, Mitt. Zool. Mus. Berlin, XX (3), p. 452—Wamal and Welbuti) but apparently lack of comparative material precluded recognition of its status. I have no material from the western part of south New Guinea, and Ogilvie-Grant (1915, Ibis, Jub. Sup., p. 304) made no comment on Mimika River birds.

MATERIAL.—Tarara, 3 ♂, 1 ♀; Mabadauan, 2 ♂, 1 ♀; Daru, 1 ♀, 1 sex (?); Wuroi, 1 ♂; Dogwa, 1 ♂; Lake Daviumbu, 5 ♂, 6 ♀.

***Macropygia amboinensis balim*, new subspecies**

TYPE.—No. 306381, Amer. Mus. Nat. Hist.; ♀ ad.; 1600 meters altitude, Balim River, Netherland New Guinea; December 11, 1938; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Differs from *keritingi* of north and south New Guinea, and from *cinereiceps* of eastern New Guinea in its larger size (♂ 175–182 mm. against 157–168, north New Guinea, 160–173, south New Guinea); in the much paler and more whitish breast and abdomen; and in the duller, less rufous brown upperparts. These color differences are more pronounced in the female, which also has the top of the head much paler, less brownish.

WING.—♂ ad. 175 mm., 176, 177, 180, 181, 182; ♀ ad. 167, 171, 173, 175, 176, 177.

RANGE.—Known only from the type locality; perhaps restricted to this high mountain valley.

REMARKS.—It is interesting to find this sharply differentiated population in a high, ecologically isolated valley in the center of New Guinea, while large series from various other parts of New Guinea show only slight variation from locality to locality, making separation into only ill-defined subspecies possible.

Gallicolumba rufigula

There has been doubt cast on the validity of the two proposed races in this species (Hartert, 1930, Nov. Zool., XXXVI, p. 117; Peters, 1937, Check-list of Birds of the World, III, p. 134). Junge (1937, Nova Guinea, p. 141), however, recognized two races.

An examination of forty-one specimens of adults from various parts of New Guinea and the Aru Islands (I have no material from the western Papuan islands) reveals that geographical variation in this species is greater than has been realized and three hitherto unnamed subspecies as well as the two named forms must be recognized. The main characters on which I separate these five races are (1) the presence or absence of a pronounced gray area on the side of the head; (2) the width and shade of the gray edgings of the upper wing-coverts. There are other, less pronounced characters which also vary geographically but are subject to more individual variation, such as the brownish or vinaceous shade of the upperparts, and the intensity of this color; the distinctness of the dark area on the nape; and the color of the forehead and crown.

The birds of the fresh (1939) series from north New Guinea all have the breast orange yellow. Only one other bird in the rest of the series approaches them in this (a Weyland Mountains, 1930, ♂). Of this bird Rothschild wrote that the whole breast and upper abdomen were bright orange golden (1931, Nov. Zool., XXXVI, p. 275); this certainly would not be said of the specimen now. All the old specimens have the breast whitish. In more recent specimens, with yellowish in the breast, the concealed portions of the feathers are brighter yellow than the exposed tips. Thus the yellow color of the breast appears to fade greatly, and though there may be geographical as well as individual variation in this character, I cannot use it.

Some specimens have the tips of some feathers of the abdomen blackish, apparently the result of staining.

***Gallicolumba rufigula rufigula* (Pucheran)**

Peristera rufigula PUCHERAN, 1853, Voy. Pole Sud, III, p. 118—Triton Bay.

DIAGNOSIS.—Characterized by the presence of the distinct gray area on the side of the head; and the wide, clear gray edgings of the upper wing-coverts, contrasting sharply with the color of the wing and back.

WING.—♂ ad. 132 mm., 133, 136, 140; ♀ ad. 139.

RANGE.—Arfak to the Weyland Mountains; probably the birds from the Mimika River discussed by Ogilvie-Grant (1915, Ibis, Jub. Sup., p. 313) belong here.

REMARKS.—The Arfak birds are slightly more brownish above than the Weyland Mountains birds, but this difference is slight.

MATERIAL.—Arfak, 3 ♂, 1 ♀, 1 sex (?); Triton Bay, 1 sex (?); Weyland Mountains, 4 ♂.

***Gallicolumba rufigula septentrionalis*,
new subspecies**

TYPE.—No. 306380, Amer. Mus. Nat. Hist.; ♂ ad.; at 50 meters altitude, Bernhard Camp, Idenburg River, Netherland New Guinea; April 16, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Differs from *rufigula* in the very much narrower gray edgings to the upper wing-coverts; in the somewhat darker and more brownish crown; in the less pronounced dusky area on the nape; and in the slightly more intensely colored upperparts.

WING.—♂ ad. 128 mm., 130, 131; ♀ ad. 125, 129, 131.

RANGE.—North New Guinea, from the Huon Peninsula to the Mamberamo River at least; found up to 850 meters altitude.

REMARKS.—The upperparts of this series are slightly more red-brown than in Arfak birds; less vinaceous than in Weyland Mountains birds.

MATERIAL.—Bernhard Camp, 4 km. southwest, 2 ♀ ad.; Bernhard Camp., 2 ♂ ad., 1 ♀ ad.; Humboldt Bay, 1 ♂, 1 sex (?); Sattelberg, 1 sex (?).

***Gallicolumba rufigula orientalis*,
new subspecies**

TYPE.—No. 419462, Amer. Mus. Nat. Hist.; ♂ ad.; Kubuna, 100 meters altitude, Central Division, Territory of Papua, New Guinea; December 15, 1933; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differs from *rufigula* and *septentrionalis* in having the edgings of the upper wing-coverts intermediate in size between those

of the above two forms; and in their gray color being considerably duller, offering less contrast with the coloring of the wing and the back; and in having the gray area of the side of the head less distinct. From *rufigula*, also differs in having the crown averaging browner. From *septentrionalis*, also differs in having the dusky area on the nape more pronounced; and the upperparts slightly duller and paler.

WING.—♂ ad. 129 mm., 133, 133, 133, 134, 136, 137, 137, 139; ♀ ad. 126, 138.

RANGE.—Southeast New Guinea westward on the north coast to the Mambare River; on the south coast to the Yule Island area; found up to 100 meters altitude.

REMARKS.—Hartert (*loc. cit.*) said that both *rufigula* and *helviventris* occurred in southeast New Guinea, but this is not apparent in this material. All specimens distinctly have the gray area in the side of the head, although it is less distinct than in the above two forms.

MATERIAL.—Lower Mambare River, 1 ♀ ad.; Milne Bay, 2 ♂ ad.; Port Moresby to Yule Island area, 8 ♂ ad., 2 ♀ ad.

Gallicolumba rufigula alaris, new subspecies

TYPE.—No. 425514, Amer. Mus. Nat. Hist.; ♂ ad.; Lake Daviumbu, Fly River, Territory of Papua, New Guinea; August 28, 1936; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differs from *rufigula*, *septentrionalis* and *orientalis* in lacking the gray area on the side of the head. The edgings of the upper wing-coverts are of medium size and contrast sharply with the color of the wing and back.

WING.—♂ ad. 133 mm., 138, 138, 139; ♀ ad. 131, 132, 134, 137.

RANGE.—South New Guinea, from the Setekwa to the Fly River; found up to 100 meters altitude.

REMARKS.—There is some geographical variation in the birds I have included in this subspecies; the upper Fly River birds and the Setekwa River birds are about like the southeast New Guinea *orientalis* in the color of the upperparts; the middle Fly River birds are somewhat lighter in general coloration above, with more of a brownish tinge to the plumage.

MATERIAL.—Sturt Island Camp, Fly River, 1 ♂ ad., 1 ♀ ad.; Lake Daviumbu, 1 ♂ ad., 1 ♀ ad.; Palmer Junction Camp, Fly River, 1 ♀ ad.; Black River Camp, Fly River, 1 ♀ ad.; Setekwa River, 2 ♂.

Gallicolumba rufigula helviventris (Rosenberg)

Ptilopus helviventris ROSENBERG, 1867 (1866), *Natuurk. Tijdschr. Nederl. Indie*, 29, p. 144—Aru Islands.

DIAGNOSIS.—Agrees with *alaris* in lacking the gray area on the side of the head; differs from it in having the gray edgings of the upper wing-coverts, which are of medium width, heavily tinged with vinaceous so that they contrast little with the color of the wing and back.

WING.—♂ 134 mm., 137.

RANGE.—Aru Islands.

REMARKS.—Both specimens I have are rather dark above, tinged with brownish; the fore crown is rather brownish; and the dusky area on the nape fairly well developed.

MATERIAL.—Aru Islands, 2 ♂.

Trichoglossus haematodus caeruleiceps D'Albertis and Salvadori

Tarara: 7 ♂, 8 ♀; December 7–January 23.

Daru: 4 ♂, 1 ♀; March 11–June 16.

Gaima: 1 ♂, 1 ♀; November 18, 19.

Lake Daviumbu: ♂, 4 ♀; September 14–18.

Found near sea level.

WING.—♂ (10) 134–148 mm. (av. 140.4); ♀ (10) 132–140 (av. 136.9).

These average considerably smaller than *nigrogularis* from the Aru Islands (♂ (10) 149–158 (av. 153); ♀ 147, 148, 150, 152) as van Oort (1909, Nova Guinea, p. 74) had pointed out.

Psittaculirostris salvadorii (Oustalet)

Bernhard Camp: 1 ♀; May 4.

Found at 50 meters altitude.

WING.—109 mm.

This specimen compares well with the description of a female given by Salvadori (1891, Cat. Bds. Brit. Mus., XX, p. 90). This is a very rare bird in collections. It is so unlike *edwardsii*, which has been recorded from Humboldt Bay, that it seems advisable to consider it a different species giving us three species in the genus: *desmarestii* with several races, *edwardsii* and *salvadorii*. According to present knowl-

edge the forms in this genus represent each other geographically.

***Psittacella modesta subcollaris*, new subspecies**

TYPE.—No. 305668, Amer. Mus. Nat. Hist.; ♂ ad.; at 1800 meters altitude, 15 km. southwest of Bernhard Camp, Idenburg River, Netherland New Guinea; January 19, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Closest to *collaris* Ogilvie-Grant, from which it differs in the male by the narrower, and average brighter yellow band separating the brown of the head from the green of the back; by the darker brown top and sides of the head; by the darker brown throat; and by the slightly darker green upperparts. In the female it differs by the reduction of the yellow band on the hind neck, almost lacking in most specimens; by the much darker top and sides of the head; and by the much darker throat. From *modesta* it differs in the male by the presence of the yellow band on the hind neck; and by the darker brown top and sides of the head: in the female it differs chiefly by the darker brown of the head.

WING MEASUREMENTS

	Male	Female
<i>modesta</i>	96 mm. (1928) ¹	93 (1890) ¹
<i>collaris</i>	94, 97 (1911) ¹	91, 92, 92 (1911) ¹
<i>subcollaris</i>	94, 94, 96, 98, 99, 100	92, 95, 95, 96, 98, 102, 105

RANGE.—The north slopes of the Snow Mountains.

REMARKS.—Fading may have affected somewhat the shade of brown of the older material (dates of collection are given after the measurements) but the extent of the yellow of the hind neck would be unaffected. It is interesting that this new race is intermediate between *modesta* and *collaris* in characters, but not in geographical position. The male is closest to *collaris* in having a yellow band on the hind neck, the female is closest to *modesta* in having the yellow of the hind neck very much reduced or lacking.

***Psittacella madaraszi major* Rothschild**

Bernhard Camp, 8 km. southwest: 1 ♀; February 12.

Found at 1600 meters altitude.

WING.—95 mm.

This specimen agrees very well with two Weyland Mountains females of *major*.

¹ Year in which collected.

The forms *madaraszi* and *modesta* have variously been considered species, or races of the same species. The finding of this specimen so close to a locality where I found *modesta* makes it seem probable that they occur together in this area, and consequently it is necessary to consider them species. There is the less probable possibility that they represent each other altitudinally and that their ranges do not overlap. But since in addition there are two very different groups of closely related forms involved, the relationships of the two groups are better brought out by treating them as species as Rothschild (1936, Mitt. Zool. Mus. Berlin, XXI, p. 233) has done. These two species, with their races, are:

<i>Psittacella modesta</i>	
<i>modesta</i> Schlegel	Arfak
<i>collaris</i> Ogilvie-Grant	South slopes of the Snow Mountains
<i>subcollaris</i> Rand	South slopes of the Snow Mountains
<i>Psittacella madaraszi</i>	
<i>madaraszi</i> Meyer	Southeast New Guinea
<i>huonensis</i> Mayr and Rand	Huon Peninsula
<i>major</i> Rothschild	North slope of the Snow Mountains and the Weyland Mountains

***Eudynamys scolopacea rufiventer* (Lesson)**

Daru: 1 ♂ ad., 1 ♂ imm.; March 30.
Lake Daviumbu: 1 ♂ ad.; September 25.

Palmer Junction Camp: 1 ♀ ad.; June 3.

Found up to 80 meters altitude.

WING.—♂ ad. 185 mm., 188; ♂ imm. 180; ♀ 189.

The adult male is referred to this form because of its size; the immature male because of the dark rufous color of the remnants of the immature plumage; the adult female has the rufous plumage and patterned head characteristic of this form. In 1934 I secured two immature males in mixed plumage (wing 176, 187) at Daru. The validity of *minima* seems very doubtful (see Junge, 1937, Nova Guinea, p. 182, and Mayr and Rand, 1937, Bull. Amer.

Mus. Nat. Hist., LXXIII, p. 67). Apparently specimens of this race from the mainland of New Guinea are rare in collections.

Eudynamys cyanocephala subcyanocephala Mathews

Daru: 7 ♂ ad., 1 ♂ imm., 7 ♀; March 7–July 8.

Gaima: 1 ♂ imm.; November 11.

Sturt Island Camp: 1 ♂ imm., 1 ♀; October 29–November 1.

Lake Daviumbu: 2 ♀; September 9, 24.

Found near sea level.

WING.—♂ ad. 200 mm., 204, 204, 207, 209, 212, 219; ♂ imm. 198, 199, 207; ♀ 199, 200, 202, 203, 203, 205, 205, 207, 209, 215.

The males are distinguishable from *rufiventer* only on the basis of size; the immature males still retain part of their immature plumage, which is distinguishable from that of *rufiventer* by the paler, less rufous coloration; the females' plumage differs from that of *rufiventer* in having the crown and hind neck immaculate glossy black, a large solid black malar stripe and paler, less rufous general coloration.

Some of these birds breed in south New Guinea, as is shown by the following data:

Daru, March 3, ♀ recently finished laying;

Lake Daviumbu, September 24, ♀ ovary enlarged.

Since this form breeds in south New Guinea where *rufiventer* also occurs, it is necessary to consider them different species, not both races of *scolopacea*, as has been done hitherto.

The subspecific identity of these birds is puzzling. There is great variation in color in the series. This may be complicated by possible migrants from Australia. It is necessary to say a word about the variation in the Australian birds. The northern territory females have the crown and nape black; wing, ♀, 194–214; birds, presumably residents from Cairns and Cape York, are similar but have more black in the throat and have the white spots of the upperparts smaller; wing, ♀, 207–227. Possibly they should be separated, and the name *findersii* might apply to the eastern birds. For the present I am considering

all these as *subcyanocephala*. All New South Wales and southeast Queensland birds (*cyanocephala*) differ in having the crown and malar stripe conspicuously streaked with pale rufous; wing, ♀, 205–220. A number of birds from Cairns and Cape York, presumably winter visitors from farther south, are indistinguishable; wing, ♀, 204–217.

All the females from south New Guinea have the head and nape black. The two breeding females compare well with Cairns and Cape York resident females. Four other females (March 7, 19, July, and September 9) agree with Cairns and Cape York females on the character of the amount of black in the throat, but have larger white spots on the upperparts, agreeing better with northwest Australian birds in this; one female (October 29) has little black in the chin and larger white spots on the upperparts than in any Australian bird. Two females (April 4 and July 8) have the chin mottled black and rufous, the underparts more rufous than any Australian birds, approaching *rufiventer* in this, and the spotting on the upperparts and the barring of the tail as rufous as *rufiventer*. These are unlike any Australian birds. It is hardly likely that these last birds are hybrids with *rufiventer*, as one would expect an indication of mottling in the crown, which does not occur, if this were so.

Since part of this series is inseparable from *subcyanocephala*, I am including them all under this name despite the wide variation which is inexplicable at the present time.

I may mention here a specimen of this species from the Kumusi River (A. S. Meek, May 9, 1907, ♀, wing 212). It is indistinguishable from some specimens of *cyanocephala*, having the crown and malar area plentifully streaked, the spotting of the upperparts and the barring of the tail white, and only a rufous wash on the breast.

Thus we must consider at the present time that *Eudynamys cyanocephala* is a species with two races, *cyanocephala*, which reaches New Guinea on migration, and *subcyanocephala*, which breeds in south New Guinea, and perhaps has its numbers aug-

mented during the non-breeding season by migrants from Australia.

***Aegotheles albertisi archboldi*, new subspecies**

TYPE.—No. 305669, Amer. Mus. Nat. Hist.; ♂ adult; at 2800 meters altitude, 9 kilometers northeast of Lake Habbema, Netherland New Guinea; October 28, 1938; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Differs from *albertisi* and *salvadorii* in the darker, richer color of the upperparts; the considerably coarser dark barrings and light markings of the back, instead of vermiculations; the average darker, more richly colored and more heavily marked underparts.

WING.—♂ (10) 115–126 mm. (av. 119.3); ♀ (10) 115–127 (av. 121.7).

RANGE.—Known from the north slope of Mt. Wilhelmina, between 2200 and 3600 meters altitude.

REMARKS.—The much coarser pattern of the back is fairly constant throughout the series, but there is great individual variation in the color of this series, as in the species generally. The rufous phase is deeper and more intensely colored than the rufous phase of *albertisi*; the gray phase has more rich rufous in the back than the gray phase of *albertisi*. The race *salvadorii* is duller than *albertisi*, the rufous phase is not as bright, and the much more common gray phase has hardly any rufous in the upperparts. The markings in the back also average finer in *salvadorii*. Three Huon Peninsula birds must be included with *salvadorii*, though they average more heavily marked below, as must a Weyland Mountains and a Mount Goliath (south slope) bird, though these last two birds differ somewhat from most *salvadorii* in having the abdomen grayish buff, not whitish. The type of *wondiwoi*, which is a much larger bird, is in bright pale rufous plumage.

The ranges of the forms of this mountain species are as follows:

<i>A. a. albertisi</i>	Arfak Peninsula
<i>A. a. wondiwoi</i>	Wandamen Peninsula
<i>A. a. archboldi</i>	North of Mt. Wilhelmina
<i>A. a. salvadorii</i>	Southeast New Guinea, extending in the north to the Huon Peninsula, in the south to the Weyland Mountains

***Aegotheles insignis tatei*, new subspecies**

TYPE.—No. 426001, Amer. Mus. Nat. Hist.; ♀ adult; 80 meters altitude, 5 miles below the Palmer Junction, Fly River, New Guinea; June 2, 1936; Richard Archbold, A. L. Rand and G. H. H. Tate.

DIAGNOSIS.—Differs from the other two races of this species in the much smaller size; in the considerable reduction in the size and abundance of the white markings in the underparts and above the eyes; in the remiges having the brownish-black color restricted to the inner portion of the basal half or two-thirds of the inner web, giving a rufous brown under wing, instead of having the inner webs of the remiges brownish black; and in having the tail crossed by distinct whitish bars just below narrow indistinct dark bars.

WING.—♀ 138 mm., 145.

RANGE.—Only known from the type locality.

REMARKS.—The other two races of this species are only slightly different from each other. This new race is strikingly distinct. Both specimens are in a bright rufous plumage, as bright as the brightest specimen I have of *pulcher*, and are very similar to each other.

This species elsewhere in New Guinea is a mountain bird, in south New Guinea coming to near sea level, as do a number of other New Guinea species. This species apparently has not previously been recorded from south New Guinea.

***Collocalia whiteheadi papuensis*, new subspecies**

TYPE.—No. 305670, Amer. Mus. Nat. Hist.; ♂ adult; at 1800 meters altitude, 15 kilometers southwest of Bernhard Camp on the Idenburg River, Netherland New Guinea; January 20, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Similar to *whiteheadi* from north Luzon but differs in having the throat considerably paler, more silvery gray, contrasting with the brownish abdomen; and the upperparts slightly more iridescent.

WING.—♂ (9) 124–142 mm. (av. 134.1); ♀ 130, 134, 139, 141.

RANGE.—New Guinea; known from the Hollandia, Idenburg River, area, between sea level and 1800 meters; Mount Goliath, 5000 feet; and Baroka, near sea level.

REMARKS.—The thirteen specimens from north New Guinea all have the tarsus fairly well feathered; the Mount Goliath bird has it unfeathered, as does the Baroka

bird. There is some variation in the gloss of the upperparts; it may be either bluish or greenish. The character of the paler throat is more marked in the north New Guinea birds than in the Mount Goliath and Baroka birds.

***Alcyone pusilla laetior*, new subspecies**

TYPE.—No. 305907, Amer. Mus. Nat. Hist.; ♂ ad.; altitude 50 meters, Bernhard Camp, Idenburg River, Netherland New Guinea; April 10, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Closest to *pusilla*, from which it differs in the considerably paler, brighter blue of the upperparts, sides of the breast and flanks.

WING.—♂ ad. 51 mm., 52; ♀ ad. 51, 51.

RANGE.—Probably north New Guinea; two specimens examined from Hollandia in addition to the four from the type locality.

REMARKS.—Mayr and I (1937, Bull. Amer. Mus. Nat. Hist. LXXIII, p. 78) have already pointed out this difference of north New Guinea birds. Additional material from both north and south New Guinea shows this is not the result of individual variation.

***Campochaera sloetii sloetii* (Schlegel)**

Bernhard Camp: 3 ♂ ad., 1 ♀ (?) ad.; March 18-29.

Found at 50 meters altitude.

WING.—♂ 103 mm., 104, 104; ♀ (?) 103.

Through the kindness of Mr. Rodolphe de Schauensee, I have been able to compare this series with a series of Arfak material collected in 1938. The Arfak birds have wing measurements ♂ 101, 103, 105, 105, 107; ♀ 108. The present males differ from the Arfak males in being slightly more yellow on the back, slightly brighter orange on the rump and underparts and in having the bill slightly broader at the base. The single female differs from the Arfak female in the slightly brighter orange of the underparts, the considerably paler gray throat and the bill being slightly broader at the base. The Arfak female has more of an olive band on the breast below the gray throat, than the north New Guinea female, but the skin of the former is somewhat distorted, perhaps accounting for this in part. This suggests that with more material the

two populations may prove to be separable on the basis of the coloration of the females.

This is the first record of this species for north New Guinea.

***Sericornis beccarii idenburgi*, new subspecies**

TYPE.—No. 305908, Amer. Mus. Nat. Hist.; ♂ adult; at 1200 meters altitude, 6 kilometers southwest of Bernhard Camp on the Idenburg River, Netherland New Guinea; February 15, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—In the adult male this race has the color pattern of the *cyclopum*-group (see Mayr, 1937, Amer. Mus. Novitates, No. 904) on the forehead. It is closest to *weylandi* in the male in the general color of the upperparts; from all the *cyclopum*-group it differs in the wings in having the light markings reduced to narrow white or grayish edgings, not broad white margins; and in having the underparts much more brownish olive. From the *virgatus*-group it differs in the presence of the black and white pattern of the forehead, which is variable but always present; in the presence of an incomplete white circle about the eye; and in the average more brownish-olive underparts.

The brownish olive of the underparts suggests an approach to the variable *S. pontifex*, but that form (of which I have no material) appears to have no black and white pattern on the head.

WING.—♂ 57 mm., 60, 62, 62, 63; ♀ 58, 59, 60, 60.

RANGE.—Only known from the slopes above the Idenburg River, between 850 and 1200 meters altitude.

REMARKS.—This is one of the races of *beccarii* which show an approach to the species *nouhuysi*. However, it is still unquestionably *beccarii* and could never be referred to *nouhuysi*, as have some intermediate races, such as *pontifex*.

***Gerygone palpebrosa tarara*, new subspecies**

TYPE.—No. 426737, Amer. Mus. Nat. Hist.; ♂ ad.; Tarara, Wassi Kussa River, Territory of Papua, New Guinea; January 4, 1937; Richard Archbold, A. L. Rand and G. H. H. Tate.

DIAGNOSIS.—Intermediate between the quite different *personata* and *inconspicua*. From *personata* from Cape York it differs in the male in the much blacker, less brownish chin, throat, ear-coverts and forehead; the paler yellowish breast and abdomen; and the darker upperparts. The females differ in the considerably paler yellowish underparts; in the white throat being less sharply separated from the yellowish breast; and in the darker upperparts. In both sexes the bill averages slightly smaller (bill *tarara*—♂

11.5-15 mm., σ^7 12 *personata*— σ^7 12.5-13.5, σ^7 12.5-13.5. *personata* is conspicuous the present race differs in the male by having the black of the throat and head distinctly brownish tinged, not pure black; by having less black on the forehead; by having the underparts paler yellow and the upperparts considerably paler.

WING.— σ^7 (10) 51-58 mm. (av. 53.2); σ^7 (8) 49-54 (av. 50.9).

RANGE.—Known from the area between the Morehead River and the mouth of the Fly River.

REMARKS.—This is a very distinct race. In 1937 (Bull. Amer. Mus. Nat. Hist., LXXIII, p. 128) when Mayr and I referred Wuroi birds to *personata*, we had no comparative material. It is interesting that on the east bank of the Fly River at its mouth and on the west bank of the middle Fly River (at Lake Daviumbu) the form of *palpebrosa* which occurs is the quite different *inconspicua* Ramsay.

Myiagra rubecula rubecula (Latham)

Daru: 1 σ^7 imm., 1 σ^7 , 1 sex(?); March 21-April 8.

Gaima: 1 σ^7 imm.; November 21.

Sturt Island Camp: 1 σ^7 imm., 1 σ^7 , 1 sex(?); October 11-31.

Lake Daviumbu: 3 σ^7 ad., 5 σ^7 ; August 19-September 29.

Found near sea level between March 21 and October 31.

WING.— σ^7 ad. 75 mm., 79, 80; σ^7 imm. 74, 76, 79; σ^7 74, 74, 74, 75, 77, 80; sex(?) 75, 80.

This is the first record for this form from New Guinea, though Australian ornithologists have long assumed that it winters here.

This series differs from the resident New Guinea race in the larger bill, the longer wing and tail, and in the male in the darker, more iridescent throat and blacker lores; in these characters it compares better with the typical race *rubecula*, than with *yorki* from Cape York, where *rubecula* also occurs on migration, or with *concinna* Gould from northwest Australia.

The resident race is strictly a savanna bird, while this winter visitor is sometimes found in the edge of the forest as well as in the savanna.

Pachycephala schlegelii viridipectus Hartert and Paludan

15 km. northeast Lake Habbema: σ^7 , σ^7 ; Oct. 9-Nov. 7.

Bele River Camp: σ^7 ; Nov. 18-Dec. 1.

18 km. southwest Bernhard Camp: σ^7 , σ^7 ; January 18-28.

18 km. southwest Bernhard Camp: σ^7 , σ^7 ; February 2-7.

Found from 1800 to 2800 meters.

WING MEASUREMENTS

Altitude	Male	Female
2800 meters	90-94 mm.	87-91
2200 "	94	
2150 "	83-88	83-87
1800 "	87	82-86

The above shows that there is an increase in size with increase of altitude. In addition the birds from 2200 and 2800 meters have the back slightly more olive, less clear greenish than those from the lower altitudes on the Idenburg slopes. The present series compares well with a series from the Weyland Mountains.

This race is but slightly differentiated from *obscurior* on the basis of the slightly greener and broader breast band in the female and the less intense coloration of the abdomen in the male (though the original description states that males are alike).

Under *P. lorentzi* I have shown how Snow Mt. birds of this species have been confused with *lorentzi*.

The races of this species are:

<i>P. s. schlegelii</i> Schl.	Aitak and Wandamen Peninsulas
<i>P. s. viridipectus</i> Hart. and Paludan	Weyland and Snow Mts.
<i>P. s. cyclops</i> Hart.	Cyclops Mts.
<i>P. s. obscurior</i> Hart.	Mountains of southeast New Guinea, Huon Peninsula and ? Sepik area

Pachycephala lorentzi Mayr

Mt. Wilhelmina to 7 km. northeast: σ^7 ad., σ^7 ad.; September 5-29.

Lake Habbema: σ^7 ad., σ^7 ad.; Aug. 3-Oct. 6.

Camp 9 km. northeast of Habbema: σ^7 ad., σ^7 imm., σ^7 ad., σ^7 imm.; October 11-31.

Bele River Camp: σ^7 ad.; November 13-24.

Camp 18 km. southwest Bernhard Camp: ♂ ad., ♀ ad.; February 5-7.

Camp 15 km. southwest Bernhard Camp: ♀ ad.; January 9-18.

Found from 2200 to 3800 meters on the north slope of Mt. Wilhelmina and from 1800 to 2150 meters on the slopes above the Idenburg River.

WING MEASUREMENTS

Altitude	Male	Female
3600-3800 meters	91-95 mm.	88-93
3225 "	90-94	84-94
2800 "	86-91	85-89
2200 "		85, 86
2150 "	86	83, 83
1800 "		82

Three specimens in the American Museum from Mt. Goliath (Meek coll.), one of them taken at 5000 ft. altitude, measure, male 80, females 82, 85.

This species has always been confused with the geographical representative of *Pachycephala schlegelii* which also occurs in the Snow Mountains. It differs from *P. schlegelii* in having the male and female alike and similar to the female of *P. schlegelii*. From this it differs in the finer and usually shorter bill and in lacking the green breast band.

This species was described by van Oort in 1910 (1910, Notes Leyden Mus., XXXII, p. 213) as *Poecilodryas caniceps pectoralis* from the Hellwig Mountains.

When Rothschild and Hartert received three specimens of this species, one labeled a male and two females, they recorded them as three females of *P. s. schlegelii* (1913, Nov. Zool., p. 508). Ogilvie-Grant (1915, Ibis, Jub. Sup., p. 91) evidently received one specimen of this species from 8000 ft. on the Utkwa River and discussed it and the three Mt. Goliath birds; he received specimens of *P. schlegelii* from the same locality and called them all *obscurior*, considering van Oort's description to apply to the young male.

Mayr (1931, Mitt. Zool. Mus. Berlin, p. 673) considered examples of this species to be the females of *P. schlegelii* and, since van Oort's name was preoccupied, proposed the name *P. s. lorentzi* which must be used for this species. Junge (1939, Nova Guinea, p. 39) working over the collection

of *P. schlegelii* and *P. lorentzi* from the south slopes of Mt. Wilhelmina considered that the examples of *lorentzi* labeled male and female were the females of *P. schlegelii*, and that females of *P. schlegelii* were immature males.

However, the material from the third Archbold expedition shows clearly that *Pachycephala lorentzi* is a species with male and female similar and lacking a green breast band, inhabiting the slopes of the Snow Mts. from 1800 meters to 3800 meters, while *P. schlegelii* in which the female has a green breast band also occurs in this area from 1800 meters to 2800 meters.

The range of this species is restricted to the Snow Mountains where it is known from the southern slopes of Mt. Wilhelmina, Mt. Goliath 5000 ft., and the Utkwa River 8000 ft., in addition to the present localities.

The preceding table, giving wing length, shows that there is an increase in size with altitude. It might be possible to separate two races on the basis of size but until the distribution of such mountain forms is better understood it seems inadvisable to do this.

Three immature males and one immature female have the top and sides of the head rusty red, the chin and throat mixed rusty red and gray, under tail-coverts rusty red, and a few rusty feathers in back, wing-coverts, rump, abdomen and flanks; the rest of the plumage is similar to that of the adult.

Toxorhamphus poliopterus maximus, new subspecies

TYPE.—No. 305909, Amer. Mus. Nat. Hist.; ♂ ad.; 15 kilometers southwest of Bernhard Camp, Idenburg River, Netherland New Guinea, altitude 1500 meters; January 29, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Differs from the other two races in the longer bill, longer wing, darker greenish-gray crown and darker green back.

RANGE.—The north slope of the Snow Mountains, between 1200 and 1500 meters, west to the Weyland Mountains, between 1200 and 1700 meters altitude.

REMARKS.—Two specimens from the Weyland Mountains, collected by Stein, are still larger (♀ ad. wing, 66, bill 31; ♀

		MEASUREMENTS			
		♂ ad.	♂ imm.	♀ ad.	♀ imm.
<i>poliopterus</i> (southeast New Guinea)	Wing	67, 68 mm.		59, 61, 62	
	Bill	33, 33		28, 28, 28	
<i>septentrionalis</i>	Wing	71		63, 64	63
	Bill	30		27 5, 27.5	27.5
<i>marimus</i>	Wing	73, 78	68	62	62
	Bill	35, 36	36	30	

imm. wing 72, bill 31). Hartert et al. (1936, Mitt. Zool. Mus. Berlin, p. 193) considered the sexing incorrect because of the large size of the birds.

Melidectes torquatus mixtus, new subspecies

TYPE.—No. 306378, Amer. Mus. Nat. Hist.; ♂ ad.; Balim River, 1600 meters, Netherland New Guinea; December 12, 1938; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—This new race has a mixture of characters found in a number of other races, without obviously being intermediate between any two races. It is a large race, like *polyphonus*, but differs from it in the much paler underparts. On the upperparts it is closest to *polyphonus*, but differs in being even darker and more somberly colored, lacking the ochraceous tinge on the blackish-brown nape; and having a more blackish rump. In the color of the underparts it is closest to *nuchalis*, differing from that race in the darker, more somberly colored upperparts, the wider white margins to the back feathers and the larger size. The white throat patch is slightly larger than in any other specimens before me except some specimens of *polyphonus*, but this may be due in part to the manner of preparation of the skins. The throat wattle is rudimentary or absent.

WING.—♂ 119 mm., 120, 120, 122, 122, 123; ♀ 111, 112, 117.

RANGE.—My material is from the Balim River area, between 1600 and 2200 meters.

REMARKS.—In 1931 Mayr (Mitt. Zool. Mus. Berlin, p. 661) suggested that the Snow Mountains bird might be an undescribed race, and in 1936 described *nuchalis* from the Weyland Mountains, which is intermediate in characters between *torquatus* and *cahni*. He suggested that the Snow Mountains birds were the same. Hartert (1932, Nova Guinea, p. 475) had listed birds from the Doormanpad-Bivak (Idenburg slopes, wing ♂ 115, 117, 118, ♀ 108) as *torquatus*. Junge (1939, Nova Guinea, p. 59) compared birds from the south slopes of Mt. Wilhelmina (wing ♂ 117, ♂(?) 103) with two Doormanpad-

Bivak specimens and found them identical. Junge referred them to *nuchalis*, apparently without comparing them. These birds are definitely smaller than my series. They must be compared with other material in the light of recent discoveries before it can be decided whether they should be included with *mixtus*, or if *mixtus* is confined to high valleys in the center of the Snow Mountains.

Meliphaga analoga citreola, new subspecies

TYPE.—No. 306377, Amer. Mus. Nat. Hist.; ♂ ad.; Bernhard Camp, 6 km. southwest, Idenburg River, altitude, 1200 meters, Netherland New Guinea; March 5, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Differs from *flavida* in the shorter wing; the more slender, though not shorter bill; the slightly more yellowish underparts, especially the throat; in the much brighter, clear olive-green upperparts; and in the slightly softer, less dense rump tuft.

	Male	Female
Wing	(10) 73-79 mm. (av. 76.1)	72, 72, 74
Bill	(10) 15-17 (av. 15.8)	14, 14.5, 14.5

RANGE.—The slopes above the Idenburg River between 850 and 1200 meters.

REMARKS.—This is an altitudinal representative of *analoga*, differing in smaller size and brighter coloration. It is the most brightly colored of any of the "*Meliphaga analoga* and its allies" complex, and in wing length differs little from the smallest, *gracilis* and *orientalis*. The population of *flavida* on the Idenburg River is somewhat yellower than those at Hollandia, and on Jobi, indicating a tendency toward this race in color, though not in measurements.

Dicaeum geelvinkianum setekwa, new subspecies

TYPE.—No. 698101 Amer. Mus. Nat. Hist.; ♂ ad.; Setekwa River, 2000 ft., Netherland New Guinea; September 1, 1910; A. S. Meek.

DIAGNOSIS.—Differs from *diversum* in the much less blackish, more olive upperparts, especially on the back of the neck. The red in the plumage averages slightly lighter in color, and the red breast patch in the male is slightly larger.

WING.—♂ 50 mm., 51, 51, 54; ♀ 47, 47.

RANGE.—Known from the Setekwa River up to 3000 feet; probably occurs along the south slopes of the Snow Mountains. Its range at higher altitudes is probably taken by the larger and much darker *centrale*.

REMARKS.—Rothschild and Hartert (1903, Nov. Zool., X, p. 215) described the race *diversum* on the basis of a male from the Ambernoh [= Mamberamo] River, a male from Humboldt Bay and a female from Takar. Later series from south of the Snow Mountains were referred to this race (van Oort, 1909, Nova Guinea, p. 98; Rothschild and Hartert, 1913, Nov. Zool., XX, p. 511; Ogilvie-Grant, 1915, Ibis, Jub. Sup., p. 81; Junge, 1939, Nova Guinea, p. 48).

When Hartert received an additional specimen, a male, from Hollandia (1930, Nov. Zool., XXXVI, p. 51) he separated the two birds from the Humboldt Bay area as *simillimum*, keeping the other two north New Guinea birds and the south Snow Mountains series as *diversum*.

The additional material from north New Guinea shows that the birds from Takar, Mamberamo and Hollandia fall within the range of variation of a series from the Idenburg River, while the series from south of the Snow Mountains is different.

Thus in the lowlands north of the Snow Mountains we have *diversum* with *simillimum* Hartert as a synonym; south of the Snow Mountains lives another race, *setekwa*, and in the Snow Mountains another, dark, larger race closest to *diversum*.

***Dicaeum geelvinkianum centrale*, new subspecies**

TYPE.—No. 306379, Amer. Mus. Nat. Hist.; ♂ ad.; Balim River, 1600 meters, Netherland

New Guinea; December 16, 1938; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Closest to *diversum* from which it differs chiefly in its larger size. It also differs slightly in the more grayish breast; in the lighter flanks; and in the slightly darker upperparts.

WING MEASUREMENTS

	Male	Female
<i>centralis</i>	56, 57, 57, 58, 58, 58, 59, 59 mm.	51, 51, 52, 52, 52, 53, 55
<i>diversum</i>	49, 50, 51, 52, 52, 52, 54, 55 ¹	46, 48, 48, 48, 49, 49

RANGE.—Known only from the type locality.

REMARKS.—This is apparently a higher altitude representative of *diversum*, which is interesting, as the series was taken on the southern drainage slope of the Snow Mountains, where the much paler race *setekwa* lives in the lowlands.

***Melanocharis longicauda umbrosa*, new subspecies**

TYPE.—No. 305910, Amer. Mus. Nat. Hist.; ♂ ad.; 6 kilometers southwest of Bernhard Camp, at 1200 meters, Idenburg River, Netherland New Guinea; February 27, 1939; Richard Archbold, A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Tail as in *longicauda* and *chloris*. In the male this race differs from both these others by having the underparts much darker olive gray. From *chloris* it also differs in the much less yellowish wash on the underparts in both sexes; the female is also slightly darker below.

WING.—♂ ad. 62 mm., 62, 62, 66; ♀ 61.

RANGE.—Known only from the type locality.

REMARKS.—Three females from Arfak, one from the Weyland Mountains, and one from 6 km. southwest of Bernhard Camp all have a small white subterminal mark on the inner web of the outer tail-feathers, which is lacking in the males. Junge (1939, Nova Guinea, p. 49) records a female from Arfak as without white on the inner web of the outer tail-feathers. Junge (*loc. cit.*) records *chloris* from the south of Mt. Wilhelmina.

¹ Includes the types of both *diversum* and *simillimum*.

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THE PES OF *BAURIA CYNOPS* BROOM

BY BOBB SCHAEFFER¹

In several respects the bauriamorphs are farther advanced toward the mammals than the cynodonts and any additional information concerning the detailed morphology of the skeleton is of special interest. This study is based on an almost complete left pes of the type of the Bauriamorpha, *Bauria cynops*, which Broom found, along with the associated skull, at Winnaarsbaken, South Africa, in beds referred to the Upper Triassic. These specimens have been described by Broom (1937) and Boonstra (1938). Because of its undeniable evolutionary importance, further study of the pes was undertaken. As the result of extensive preparation, the use of roentgenograms, and the construction of a natural size model, certain features have been revealed which make a revised and more detailed description advisable.

The foot (A.M.N.H. No. 5622), with all the preserved elements in their natural positions, is complete, except for the more distal phalanges of the fifth digit. These are most certainly two in number and may be restored with confidence. The distal ends of the tibia and fibula are present and were in place when the fossil was found. The proximal ends of these bones, but from the opposite side, were also located elsewhere in the surrounding matrix.

The distal parts of the tibia and fibula were removed from the matrix before the present study was undertaken, and the proximal and distal articular surfaces were ground in an attempt to remove the very tenacious matrix. This makes it impossible to determine the exact nature of these surfaces. The distal end of the fibula has a greater diameter than that of the tibia and clearly shows two concave facets for articulation with the astragalus and cal-

caneum. The distal end of the tibia is but little expanded, with its astragalar face slightly concave. There is no indication of either an internal or an external malleolus. The upper extremity of the tibia is more expanded than that of the fibula and has a very mammal-like crest and tubercle for the attachment of the patellar ligament. Both the tibia and the fibula apparently have straight, slender shafts.

The astragalus and calcaneum are of particular interest. The latter possesses a short but well-defined tuber with a somewhat restricted neck. The presence of this tuber could not be definitely established by Broom. On the contrary, Boonstra describes a tuber, but because of an apparent detachment of its distal portion, he considers the latter to be a sesamoid bone. Further preparation for the present study demonstrates without question that the so-called sesamoid bone is merely a part of the tuber. The roentgenograms further support this conclusion.

A tuber calcis has been found by Watson (1931) on the calcaneum of the bauriamorph *Eriolacerta parva*. It is also present on the calcaneum of the primitive gorgonopsian *Scymnognathus* cf. *whaitsi* (Broili and Schröder, 1935) and the therocephalian *Ictidosuchoides intermedius* (Broom, 1938). In *Eriolacerta*, as in *Bauria*, the tuber meets the body of the calcaneum at an angle of about 140 degrees. This does not necessarily indicate, as Watson suggests, that the foot was digitigrade. The evidence rather indicates that it was plantigrade or semiplantigrade. Although, in *Scymnognathus*, the tuber does not make an angle with the body, the foot has likewise been restored as digitigrade. In mammals, true digitigradism is always associated with the development of an antilinal vertebra

¹ Department of Zoology, Columbia University.

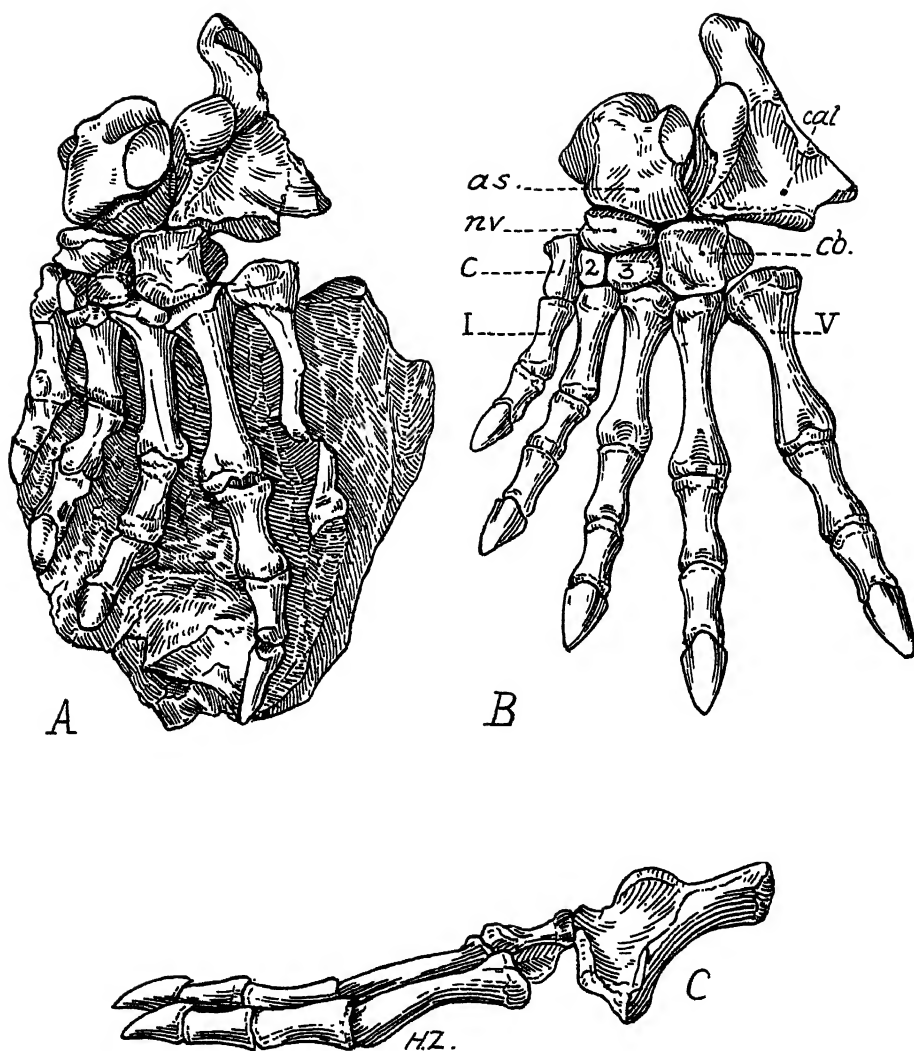


Fig. 1. Left Pes of *Bauria cynops*.

- A. Dorsal view, from specimen. Natural size.
 B. Dorsal view, from model. Natural size.
 C. Lateral view, from model. Natural size.

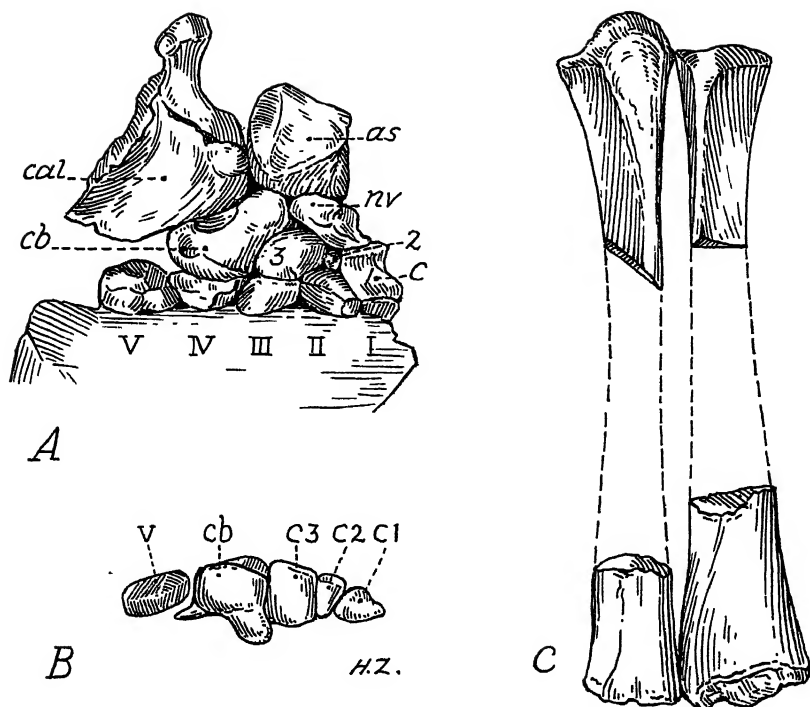


Fig. 2. A. Plantar view of tarsal region of left pes of *Bauria cynops*, from specimen. Natural size.

B. View of proximal articular surfaces of metatarsal V, cuboid (cb), and cuneiforms (c3, c2, c1) of left pes of *Bauria cynops*, from model. Natural size.

C. Anterior view of left tibia and fibula of *Bauria cynops*. Proximal portion of tibia from right side, reversed in drawing. Natural size.

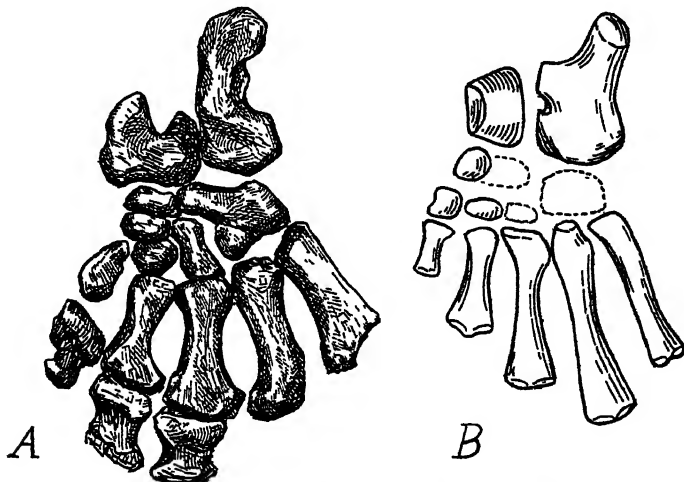


Fig. 3. A. Plantar view of right pes of *Scymnognathus* cf. *whaitisi* Broom. Astragalus should be rotated so that notched border faces laterally. After Broili and Schröder. $\times 1/2$.

B. Plantar view of left pes of *Eriolacerta parva*. Modified and reversed, after Watson, $\times 3$.

and with elongated spinous processes which slope more or less caudad anterior to and cranial posterior to this vertebra. Thus the digitigrade condition, permitting greater speed, developed coincidentally with the modifications producing a more efficient spring-like action of the vertebral column. The neural spines of *Eriolacerta* are short and directed upward or slightly caudad. This is the condition found in *Varanus* and most slowly moving mammals such as *Ornithorynchus*, *Didelphys*, and *Myrmecophaga*, which are essentially plantigrade or semiplantigrade.

The tuber of the calcaneum of *Didelphys* has an inclination similar to that of *Bauria* and *Eriolacerta*, but as the plantar surface of the foot is covered by a fibrous, fatty pad, the distal end of the tuber is well protected, and does not project ventrally beyond the plane of the sole. Such a pad was very probably present on the sole of the bauriamorph foot.

It is quite evident that the tuber made its appearance before the calcaneum lost its contact with the fibula, and that it developed primarily to increase the leverage of the foot. Morton (1935) has stated that the tuber developed, along with the superimposed astragalus, as an arboreal adaptation, permitting differentiation of the extrinsic flexors into digital flexors for grasping and into the triceps surae (gastrocnemius and soleus) inserted on the tuber for increased leverage action. The pes of *Bauria*, however, is definitely not arboreal, although there was undoubtedly almost complete differentiation of the triceps surae. The raising of the astragalus onto the calcaneum probably occurred during the stage in which the tibia became the main weight-bearing axis of the lower leg, and the fibula, reduced in importance, lost its articulation with calcaneum. This step in the evolution of the foot, together with the enlargement of the tuber, may be of arboreal significance.

The body of the calcaneum is dorsoventrally compressed, is more or less rectangular in shape, has a raised lateral border, and a basin-like central portion. The articular surface for the fibula is proximo-medial in position and is a very prominent

and well-rounded knob. The cuboid facet of the calcaneum is not rounded as in *Eriolacerta* but is quite flat. This facet articulates only with the proximolateral corner of the cuboid, but it extends laterally out over a gap above the fifth metatarsal. In *Scymnognathus* the calcaneum does not articulate with the cuboid, which is very probably the more primitive condition. The calcaneoastragalar contact is weak, as the articular facets of the related bones are narrow, plain surfaces. The roentgenograms reveal the presence of a foramen between the astragalus and the calcaneum which is not evident in the fossil itself. The plantar surface of the calcaneum is decidedly concave. There is a well-developed and knob-like medial process which extends just under the lateral border of the astragalus and serves to strengthen the calcaneoastragalar articulation. This may be the beginning of the sustentacular process.

The astragalus has a large and well-rounded tibial facet with no definite indication of a trochlea. This articular rolling surface is, of course, a heritage character, as its beginning can be traced back to such a form as the cotylosaur *Diadectes* (Romer, 1931), in which there already is considerable torsion between the crus and the foot when the leg is directed backward at the end of a stride. The articular surface for the fibula is a distinct knob with a flattened lateral surface. It is comparatively smaller in size than in other therapsids. The astragalus also possesses what may be interpreted as a true, but weakly developed head. In the actual specimen the head appears to be a separate bone, but the roentgenograms clearly demonstrate the presence of a partially matrix-filled crack running through the astragalus and calcaneum. A neck is not differentiated from the head, and the latter is not rounded distally but has two rather concave facets which articulate with the navicular and cuboid, respectively. The head cannot be observed from the plantar surface, as it is covered both by the navicular and a medial extension of the cuboid.

The navicular is a small bone with a moderate transverse elongation. The as-

trigalar facet is convex, while the distal articular surface is quite flat. The latter articulates with the ecto-, meso-, and proximolateral corner of the entocuneiform. The nature of the cuboid facet is difficult to determine, but it is probably somewhat convex.

Viewed from its dorsal aspect, the cuboid has a rectangular outline. In articulating with the astragalus head, it must have shared about equally with the navicular the weight stresses transmitted by the astragalus. Distally it articulates with

the calcaneum to the base of the fifth metatarsal. Such a gap is indicated in the pes of the therocephalian *Whaitsia*, as restored by Broom (1932) and is definitely present in certain other therapsids. Granger and Simpson (1929) have recorded the presence of a large gap in the same position in the multituberculate *Eucosmodon*, although in this case the fifth metatarsal does articulate with the extreme lateral border of the cuboid. This gap certainly was not filled by a cartilaginous fifth tarsale. Whatever the significance

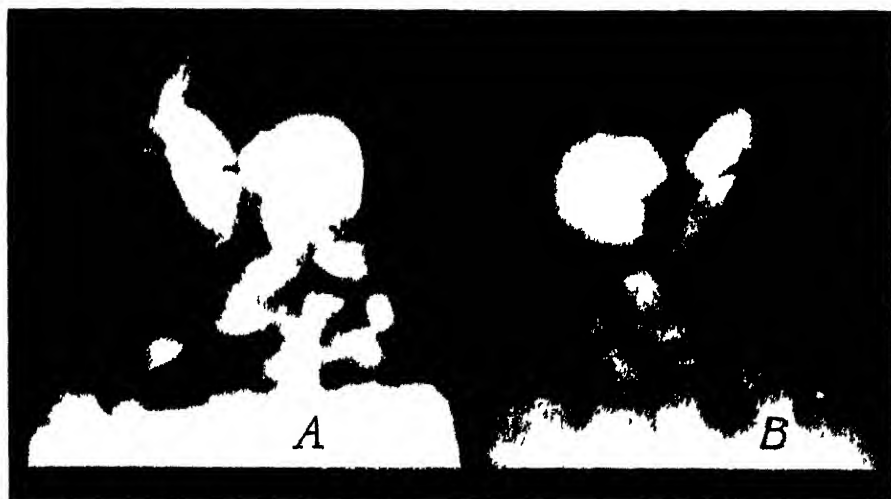


Fig. 4. Roentgenograms of Left Pes of *Bauria cynops*.

- A. Plantar view of tarsal region. Natural size.
- B. Dorsal view of tarsal region. Natural size.

the base of the fourth metatarsal. It does not articulate with the base of the fifth metatarsal and there is, in this fossil, a large gap between the distal end of the calcaneum and the base of the fifth metatarsal. Without question, the cuboid bore by far the greater part of the weight stresses transmitted from the fibula through the astragalus and calcaneum. The gap may have been filled with a lateral, fibrocartilaginous extension from the cuboid or possibly by a persistent fifth tarsale, either of which would have been capable of transmitting some pressure from

of the gap may be, the evidence indicates that no osseous element has been lost in the *Bauria* pes.

The plantar surface of the cuboid presents a very different picture. A short, rounded, dorsoventrally flattened process extends laterally into the gap. This process may have offered some support to the fibrocartilaginous portion and acted as a point of ligamentous attachment, but is otherwise, apparently, of no functional importance. There is also a very strongly developed knob-like process which extends medially and proximally, overlap-

ping somewhat the lateral border of the navicular. This process affords a bracing mechanism which, with the aid of ligaments, would tend to prevent the separation of the cuboid and navicular and thus functionally unite these bones against any possible wedging action of the astragalar head. The blood vessel passing between the astragalus and calcaneum ran above this process to reach the plantar surface.

The ecto- and mesocuneiforms articulate proximally with the navicular and distally with the third and second metatarsals. The mesocuneiform is a wedge-shaped element with its apex just slightly visible on the plantar surface. The entocuneiform is the largest of the cuneiforms and is proximodistally elongated. It barely contacts the navicular on its proximolateral corner. The position of the entocuneiform in *Scymnognathus* is most unusual. It is wedged in between the relatively small cuboid and the mesocuneiform. Whether it has been displaced or is in its natural position cannot be ascertained.

The metatarsals, as Boonstra noted, are very mammal-like in appearance. They all have expanded, well-developed osseous articular surfaces proximally and distally. The proximal surfaces, except in the case of the fifth, are flat facets, making for rather intimate contact with the tarsals. The base of the fifth is more or less rounded and somewhat rugose as if it were capped with fibrocartilage in life. The shafts of the metatarsals and also of the proximal and middle phalanges are quite circular in cross section in contrast to the flat oval condition found in more primitive therapsids. The heads are very mammalian in character, being rounded and separated from the shafts by a distinct groove.

The phalangeal formula is 2-3-3-3-3. The bases of the proximal phalanges are expanded and concave. The heads are transversely cylindrical. The middle phalanges have a concave base with a fairly well-developed proximodorsal process for the attachment of the extensor tendons. The terminal phalanges taper to a blunt point and are not transversely compressed. They also have a proximodorsal process.

MEASUREMENTS IN MILLIMETERS

Metatarsals	Middle Phalanges
I—10	
II—12.5	II—7.5
III—20.5	III—9.5
IV—24	IV—10.5
V—23	V—?
Proximal Phalanges	Distal Phalanges
I—7.5	I—7.5
II—8.5	II—?
III—10.5	III—?
IV—13	IV—9.5
V—?	V—?

The pes as a whole exhibits a degree of consolidation not found in any of the lower therapsids, possibly excepting *Scymnognathus*. The more or less interlocking condition of the tarsal bones, so characteristic of the mammalian foot, is definitely indicated. Several features support the conclusion that there was a low transverse tarsal arch, namely, the indication of a well-developed cuboideonavicular ligament, the wedge-shaped mesocuneiform, and possibly the rudimentary sustentacular process. The digits increase in length up to the fourth, with the fifth about the same length as the third. The fifth digit was probably slightly divergent. That the type of locomotion was like that of a modern lizard, as Boonstra suggests, would appear very doubtful in view of the fact that the long axis of the foot must have been almost parallel to the long axis of the body. The pes of *Bauria* is unquestionably the closest known approach to the mammalian foot among the therapsid reptiles.

The roentgenograms have been of great assistance in this study, and some information concerning them may be of interest. A properly exposed roentgenogram can be of great value in many types of paleontological research, as many of Peyer's papers will testify. In this case it is only through the use of the x-rays that the true existence of a crack in the astragalus can be demonstrated. The outlines of the bones are also very clearly defined. The extremely hard and tenacious matrix has made complete preparation almost impossible. It consists of a very resistant hematitic limestone which is almost impervious to the x-rays, and good results were

only attained after the greater part of the matrix was removed from the tarsal region. The foot was successfully roentgenographed at a focal target distance of 30 inches, kilovoltage 55, milliamperage 50 for 3 seconds. The type, density, and thickness of the matrix, as well as the fos-

silization of the specimen, are all factors which must be considered.

The writer is indebted to Dr. W. K. Gregory and Mr. H. C. Raven for their interest and helpful suggestions and to Dr. E. P. Pendergrass for preparing the roentgenograms.

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NEW BRACHYURA FROM THE GULF OF DAVAO, MINDANAO, PHILIPPINE ISLANDS

BY MELBOURNE WARD¹

This report is based on two collections made on the coral reefs and beaches and in shallow water along the western coast of the Gulf of Davao. Much the larger part of the material was collected by Mr. Godfred R. Oesch during the months March to July, 1936; the remainder of it was collected by Dr. Willard G. Van Name in November, 1937, in the same general region.

I wish to express my gratitude to Dr. Roy Waldo Miner, Curator of Living Invertebrates, of The American Museum of Natural History, New York, and Dr. Willard G. Van Name for allowing me to study this most interesting material.

In this article I establish a new genus of Grapsidae, *Parapyxidognathus*, with *Pyxidognathus deianira* de Man, 1888, as the type.

The following 15 new species are described:

Heteronucia oeschi
Huenia brevifrons
Charybdis vannamei
Charybdis philippinensis
Charybdis padadina
Actaea paraspectiosa
Leptodius davaoensis
Chlorodiella davaoensis
Chlorodopsis philippinensis
Sphaerosius oeschi
Ruppeloides philippinensis
Actumnus davaoensis
Eriphia pilumnoides
Trapezia davaoensis
Trapezia plana

Also the following new subspecies:

Actaea subpunctata philippinensis
Leptodius sanguineus philippinensis

One new name, *Trapezia miersi* (for *T. guttata* Miers, 1888), is proposed.

The following previously known Brachyura were comprised in the two collections:

SUBTRIBE DROMIACEA

Dromiidae

Cryptodromia tumida Stimpson, 1858
Cryptodromia bullifera Alcock, 1899
Cryptodromia canaliculata Stimpson, 1858

SUBTRIBE OXYSTOMATA

Calappidae

Calappinae

Calappa philargius (Linnaeus), 1758
Calappa hepatica (Linnaeus), 1758

Matutinae

Matuta crebrepunctata Miers, 1877
Matuta banksii Leach, 1817

SUBTRIBE BRACHYRHYNCHA

Majidae

Inachinae

Camposcia retusa Latreille, 1829

Majinae

Tiarinia tiarata (Adams and White), 1848
Tiarinia gracilis Dana, 1852
Tiarinia angusta Dana, 1852
Tylocarcinus styx (Herbst), 1803

Pisinae

Hyastenus auctus Rathbun, 1916
Hyastenus borradalei Rathbun, 1907

Schizophrysinae

Schizophrys spiniger Adams and White, 1848

Micippinae

Micippa bicarinata Adams and White, 1848

Parthenopidae

Parthenopinae

Daldorfia horrida (Linnaeus), 1758

SUPERFAMILY BRACHYRHYNCHA

Portunidae

Thalamitinae

Portunus sanguinolentus (Herbst), 1803
Lupocyclopotus gracilimanus (Stimpson), 1858

¹ F. R. Z. S., F. Z. S., Honorary Zoologist, Australian Museum, Sydney, Honorary Collector, Queensland Museum, Brisbane.

Thalamita admixta (Herbst), 1803
Thalamita picta Stimpson, 1858
Thalamita crassimana Dana, 1852
Thalamita crenata Latreille, Edwards, 1834
Charybdis annulata (Fabricius), 1798
Charybdis orientalis (Dana), 1852
Goniobellinus hongkongensis Shen, 1934

Caphyrinae

Caphyra laevis A. M. Edwards, 1869
Goniocaphyra truncatifrons de Man, 1888

Catoptrinae

Catupa laeviuscula Heller, 1865

Podophthalminae

Podophthalmus vigil Fabricius, 1798

Atelecyclidae

Kraussia integra de Haan, 1837
Kraussia porcellana (Adams and White), 1849

Xanthidae¹

Carpilius convexus (Forsk.) 1777
Carpilodes cinctimanus (White), 1847
Carpilodes bellus (Dana), 1852
Carpilodes laevis A. M. Edwards, 1873
Neolimera sunduica (de Man), 1888
Zozymus acutus (Linnaeus), 1758
Zozymodes pumilis (Lucas), 1853
Atergatis subdivisus Adams and White, 1849
Atergatis ocyrops (Herbst), 1801
Actaea tomentosa (H. M. Edwards), 1834
Actaea hirsutissima (Ruppell), 1830
Actaea scabra H. M. Edwards, 1834
Actaea modesta (de Man), 1888
Actaea ruppellii (Krauss), 1843
Banania armata A. M. Edwards, 1869
Platypodia maculata (de Man), 1888
Platypodia sumigranosa (de Man), 1902
Platypodia anaglypta (Heller), 1861
Platypodia granulosa (Ruppell), 1830
Ralumia dahli Balss, 1933
Leptodius cavipes (Dana), 1852
Leptodius nudipes (Dana), 1852
Leptodius crassimanus A. M. Edwards, 1867
Leptodius cristatus Borradaile, 1903
Xanthias gnosomanus (Dana), 1852
Paraxanthias notatus (Dana), 1852
Paraxanthias pachydactylus (A. M. Edwards), 1879
Euxanthus punctatus A. M. Edwards, 1865
Ozius rugulosus Stimpson, 1858
Epixanthus frontalis (H. M. Edwards), 1834
Chlorodopsis hirtipes (Adams and White), 1849
Chlorodopsis pilumnoides (Adams and White), 1849
Chlorodopsis melanochirus A. M. Edwards, 1873
Pilodius pubescens Dana, 1852

Phymodius sculptus (A. M. Edwards), 1873
Phymodius unguatus (H. M. Edwards), 1834
Etisus laevis (Randall), 1839
Etisodes demani Odhner, 1925
Liozantho laevadorsalis (Miers), 1886
Eriphia subana (Shaw), 1803
Cymo melanodactylus de Haan, 1833
Cymo deplanatus A. M. Edwards, 1873
Trapezia reticulata Stimpson, 1858
Trapezia cymodoce (Herbst), 1801
Tetralia glaberrima (Herbst), 1790
Pilumnus scabriculus Adams and White, 1849
Pilumnus respektilio (Fabricius), 1789
Pilumnus striatus de Man, 1888
Pilumnus forskali bleekeri Miers, Balss, 1933
Pilumnus haswelli de Man, 1888
Pilumnus barbatus A. M. Edwards, 1873
Pilumnus caeruleus A. M. Edwards, 1873
Glabropilumnus edamensis (de Man), 1888
Glabropilumnus dispar (Dana), 1852
Parapilumnus quadridentatus de Man, 1895

Grapsidae

Grapsinae

Grapsus strigosus (Herbst), 1799
Metopograpsus gracilipes de Man, 1888
Metopograpsus oceanicus (Lucas), 1842
Metopograpsus latifrons (White), 1847
Pachygrapsus minutus A. M. Edwards, 1873
Pachygrapsus planifrons de Man, 1888

Plagusinae

Plagusia immaculata Lamarck, 1818
Peron planissimus (Herbst), 1804
Peron demani Ward, 1934

Sesarminae

Sarmatium indicum A. M. Edwards, 1868
Parasarma butarica (Moreira), 1903
Parasarma lenzi de Man, 1889
Parasarma adamensis de Man, 1888
Parasarma moluccensis de Man, 1892
Metasarma rubyi A. M. Edwards, 1869
Sesarma peraccae Nobili, 1903
Sesarma taeniolum White, 1847
Sesarma brockii de Man, 1888
Sesarma rotundifrons A. M. Edwards, 1869
Chiromantes sumperi Bugei, 1893
Chiromantes onychophora de Man, 1895
Holometopus villosus (A. M. Edwards), 1869
Clistoroloma tectum Rathbun, 1914

Varuninae

Ptycognathus pilipes A. M. Edwards, 1868
Ptycognathus guiljugani Rathbun, 1914
Ptycognathus affinis de Man, 1895
Ptycognathus riedelii A. M. Edwards, 1868
Pseudograpsus crassus A. M. Edwards, 1868
Varuna litterata (Fabricius), 1798

Ocypodidae

Ocypodinae

Ocypoda ceratophthalma (Pallas), 1767-1780
Ocypoda cordimana Desmarest, 1825

¹ The Xanthidae here recorded have not been placed in subfamilies, owing to the unsatisfactory state of the classification.

Ilyoplax integer Tesch, 1918
Dotilla wichmanni de Man, 1892
Tmethypocoelis ceratophorus (Koebel), 1897
Mycteris brevidactylus Stimpson, 1858
Uca zamboangana Rathbun, 1913
Uca mearnsi Rathbun, 1913
Uca marionis (Desmarest), 1825
Uca variabilis (de Man), 1891
Uca demani Ortman, 1897
Uca rathbuni Pearse, 1912
Macrophthalmus transversus (Latreille), 1817
Macrophthalmus latreilli Desmarest, 1822
Macrophthalmus crinitus Rathbun, 1913
Macrophthalmus granulosus de Man, 1904

TRIBE BRACHYURA

SUBTRIBE OXYSTOMATA

Leucosiidae

HETERONUCIA ALCOCK

Heteronucia ALCOCK, 1896. Journ. Asiat. Soc. Bengal, LXV, part 2, No. 2, p. 177.

HAPLOTYPE.—*Heteronucia resciculosa* Alcock.

TYPE LOCALITY.—Off Ceylon, 34 fathoms.

Heteronucia oeschi, new species

Figures 1 and 2

Carapace covered with coarse pearly granules. The gastric regions are defined by two broad and deep sulci which form a narrow triangle, the apex lying between the teeth of the front and the base separates the intestinal regions from the posterior margins of the carapace. There are four large inflations placed transversely, two on each side of the gastric triangle. The subhepatic regions are produced into broadly triangulate lobes. The posterolateral margins are armed with short cylindrical spinules. All the sternal surfaces are covered with coarse granules.

The chelae are short and thick and very coarsely granulated.

HOLOTYPE.—Female measuring 6 mm. in maximum width of the carapace.

LOCALITY.—Collected by Godfred R. Oesch, for whom the species is named. March to July, 1936.

Majidae

Acanthonychinae

HUENIA DE HAAN

Huenia DE HAAN, 1839, in Siebold, Fauna Japon., Crust., 83.

HAPLOTYPE.—*Huenia proteus* de Haan.

TYPE LOCALITY.—Japan.

Huenia brevifrons, new species

Figures 3 and 4

The carapace is as broad as it is long. The anterolateral margins are developed into petaloid processes; there is a smaller lobe on the posterior margin. The posterior margin is developed into a raised lamina, the outer angles of which are acclivous and rounded.

The rostrum is broadly triangulate without prolongation and is fringed on each side with hooked hairs. The supraocular eave is produced into a short tooth anteriorly. The eyes are large and appear to be rigid. The ambulatory legs are short and compressed.

I have material of *Huenia proteus* de Haan from Japan and note the following characters by which the two species may be differentiated.

1.—The form of the petaloid processes on the anterolateral margins of the carapace.

2.—The short rostrum of *H. brevifrons*.

3.—The short spines on the supraorbital eave of *H. brevifrons*.

4.—The shorter ambulatory legs of *H. brevifrons*.

MATERIAL.—Holotype, female, 10 mm. (Cat. No. A.M.N.H. 8328). Collected by G. R. Oesch.

Portunidae

Thalamitinae

CHARYBDIS DE HAAN

Charybdis DE HAAN, 1833, Fauna Japon., Crust., 3, 10.

TYPE.—*Charybdis japonicum* A. M. Edwards = *Charybdis sexdentatus* de Haan (not Herbst).

The following species are known to me by examination of specimens:

Charybdis nutator (Herbst), (Queensland and Northern N. S. W. *Charybdis cruciata* (Herbst), India and Eastern Australia as far south as Sydney. *Charybdis miles* de Haan, Japan; *Charybdis spiniferum* Miers, Eastern Australia. *Charybdis anisodon* de Haan, Singapore; *Charybdis variegata* (Fabricius), Singapore. *Charybdis callianassa* (Herbst), Penang; *Charybdis incisa* Rathbun, Queensland and as far south as Sydney; *Charybdis orientalis* Dana, Davao, Philippine Islands; *Charybdis jaubertensis* Rathbun, Broome; *Charybdis merguensis* de Man, Singapore; *Charybdis affinis* Dana, Singapore; *Charybdis acutifrons* de Man, Port Moresby and Queensland; *Charybdis japonica* A. M. Edwards, Japan and China; *Charybdis bimaculata* Miers. *Charybdis rostrata* A. M. Edwards, India. *Charybdis annulata* (Fabricius), Davao, Philippine Islands.

Leene (1938) has given a most interesting

study of *Charybdis* in Siboga Expeditie, Monog. XXXIXc³, VII, but there are several specimens in the present collection which I have been unable to reconcile with her descriptions and, after a careful search through the literature, I have come to the conclusion that they represent three new species.

Charybdis vannamei, new species

Figures 5 and 6

Carapace broader than long, smooth and glossy to the unaided eye, finely granulated under a lens. There are four granulated transverse ridges on the anterior half of the carapace; the first is placed on the epigastric region and is broken into two by a broad shallow sulcus which extends back from the incision between the median pair of frontal teeth; the second ridge is also divided into two and more widely separated than the epigastric ridges. The third ridge is entire and concave. The fourth ridge extends from the last tooth of the anterolateral margin and is broken on each side of the gastric region at the cervical groove. The cardiac region is separated from the gastric and branchial regions by an H-shaped depression.

The hepatic regions are slightly sunken below the level of the rest of the carapace and there are a few scattered punctations.

The anterolateral margins are divided into six subequal teeth, the first and the last are the smallest, the third and the fourth are the largest. The posterolateral margins are convex with an indistinct line of granules outlining the margin, this ridge does not reach the posterior margin of the carapace. The posterior margin is developed into a sharp granular ridge. The epimeral walls of the carapace are slightly inflated, finely granular and clothed with a scant coat of fine hairs which become more numerous and coarse toward the teeth of the anterolateral margins and can be seen as a fringe upon the anterior margin of each tooth.

The orbits are large, the width equal to one-third the length of the carapace, without dorsal inclination. The upper border is broken by two narrow fissures, a third is present below the outer angle; the inner angle is obtuse, produced as far as the outer angle and is slightly broader than the two submedian frontal teeth. The lower orbital border is granulated, the inner angle is obtuse and not as produced as the inner angle of the upper border. The orbital hiatus is occupied by the short prolongation of the base of the antenna; a broad V-shaped space exists between the lower orbital border and the side of the prolongation, the upper margin is in close contact with the upper margin of the hiatus. A well-developed granulated ridge extends along the anterior part of the base of the antenna.

The front is divided into six teeth, excluding the orbital angles; the median pair of teeth are

rounded, separated by a narrow V-shaped incision and placed on a lower plane than the other teeth, the submedian pair are more triangulate with obtuse tips, the outer pair are the narrowest and directed slightly outward. The antennules are large and transversely directed. The epistome is smooth, narrow and sunken in the median line.

The buccal orifice is not quite closed by the external maxillipeds. The merus of the external maxillipeds is equal to half the length of the ischium, the outer angle is produced into a narrow auriculate angle. There are two broad sulci on the outer surface with patches of granules and coarse golden hairs near the margins. The palp is large and fringed with coarse golden hairs. The ischium is flat and flossy with a deep longitudinal sulcus parallel to the inner margins.

The sternum is smooth.

The chelae are subequal. The merus is armed with three spines on the anterior margin, other surfaces quite smooth. The carpus is armed with four spines, the largest of which is upon the inner angle; an obsolete ridge extends along the anterior side of this spine and continues almost to the posterior articulation with the merus. The other three spines are placed in a triangle on the outer surface of the carpus, the two lower are on the margin; obsolete ridges extend from them toward the posterior articulation with the merus and resemble the ridge from the large spine on the inner angle. The manus of both chelae is slightly inflated and finely granulated; the granules tend to form a venose pattern visible only under a lens; five spines are present on the upper surface—one at the articulation with the carpus, three of almost equal size distally; two of the latter are on the inner margin; a minute spine is placed above the articulation of the dactylus. Three smooth longitudinal ridges are placed upon the outer surface, the lowest is the most developed and extends from the tip of the immobile finger becoming obsolete proximally and not reaching the articulation with the carpus. The second ridge extends from an abrupt elevation near the gape and ends abruptly at the articulation with the carpus. The third ridge is the shortest and most indistinct. The dactylus and immovable finger are longitudinally grooved, four grooves on each.

The ambulatory legs are slender and unarmed, finely granulose and punctate. The merus of the fifth leg is twice as long as it is wide, compressed and punctate. The carpus is compressed, longer than broad, armed below at the propodal articulation with a long sharp spine. The lower margin of the propodus is armed with ten small spines. All the articles of the fifth leg are fringed with pale brown hair.

The abdomen of the male is narrow. The penultimate segment is as broad as long, the anterior angles are abruptly rounded.

HOLOTYPE.—Male 54 mm. (Cat. No. A.M.N.H. 8507), collected by Dr. W. G. Van Name.

ADDITIONAL MATERIAL.—One female 41 mm., collected by Godfred R. Oesch.

Charybdis vannamei and *C. spiniferum* Miers differ in the following characters:

1.—The teeth of the front are more acute and longer and more separated in *C. spiniferum*.

2.—The penultimate segment of the abdomen of the male has its margins more evenly curved in *C. spiniferum*.

3.—The spines of the anterolateral margins are more slender in *C. spiniferum*.

C. vannamei differs from *C. merguensis* de Man in the following characters:

1.—In the pleopods of the male being longer, more slender and undulate.

2.—In the outline of the abdomen of the male.

3.—In having the teeth of the front more widely separated.

4.—In having the anterolateral margins more transversely directed.

5.—In having the anterolateral angle of the merus of the external maxilliped produced into a more acutely auriculate angle.

Charybdis philippinensis, new species

Figures 7 and 8

The carapace is broader than long; bare and glossy, granulated under lens. Four ridges across the carapace placed as in *C. vannamei*; the first is obsolete and the others are less developed than in *C. vannamei*.

The front is equal to one-fourth the width of the carapace and is cut into six teeth excluding the inner orbital angles. The submedian teeth are the broadest, truncated and sloping toward the median teeth, the lateral pair are narrow obtuse and sloping inward.

The anterolateral margins are armed with six spines, including the outer orbital angle; the spines become larger posteriorly; the last is transversely directed and twice as long as any of the others. The posterolateral margins are strongly convergent and outlined by a fine ridge which ends abruptly close to the raised edge of the epimeral wall between the fourth and fifth ambulatory legs. A strong ridge outlines the edge of the epimeral wall and continues unbroken into the posterior margin of the carapace.

The orbits are small, dorsally directed so that the entire lower margin is visible from a dorsal view when the eyes are retracted; two obsolete fissures in the upper margin, one below the outer angle. The outer angle is formed by a tooth similar in shape to that in *C. cruciata* (Herbst). The orbital hiatus is filled by the prolongation of the base of the antenna but is extremely short.

The epistome is well developed though sunken. The buccal orifice is completely closed by the external maxillipeds. The external maxillipeds resemble those of *C. vannamei*.

The chelae are subequal. The merus is armed on the anterior margin with two spines and granules, the latter continue onto the upper sur-

face and form a distinct patch becoming reduced in size toward the center. The carpus is armed with four spines, the largest of which is on the inner angle; the upper surface is granulated. The manus is very much inflated proximally and armed above with two spines placed side by side at some distance from the articulation of the dactylus; strong ridges of granules extend posteriorly from these spines. Three broad and low ridges extend longitudinally along the outer surface. The dactylus is equal to the length of the upper border of the manus; both fingers are strongly curved inward toward the front of the carapace, the teeth on both fingers are tricuspidate and interlocking and the tips cross when gripping.

The ambulatory legs are long and slender; the distal articles are fringed with long hair.

HOLOTYPE.—Male 35 mm. (Cat. No. A.M.N.H. 8382), collected by Godfred R. Oesch.

ADDITIONAL MATERIAL.—One male 32 mm., collected by Godfred R. Oesch.

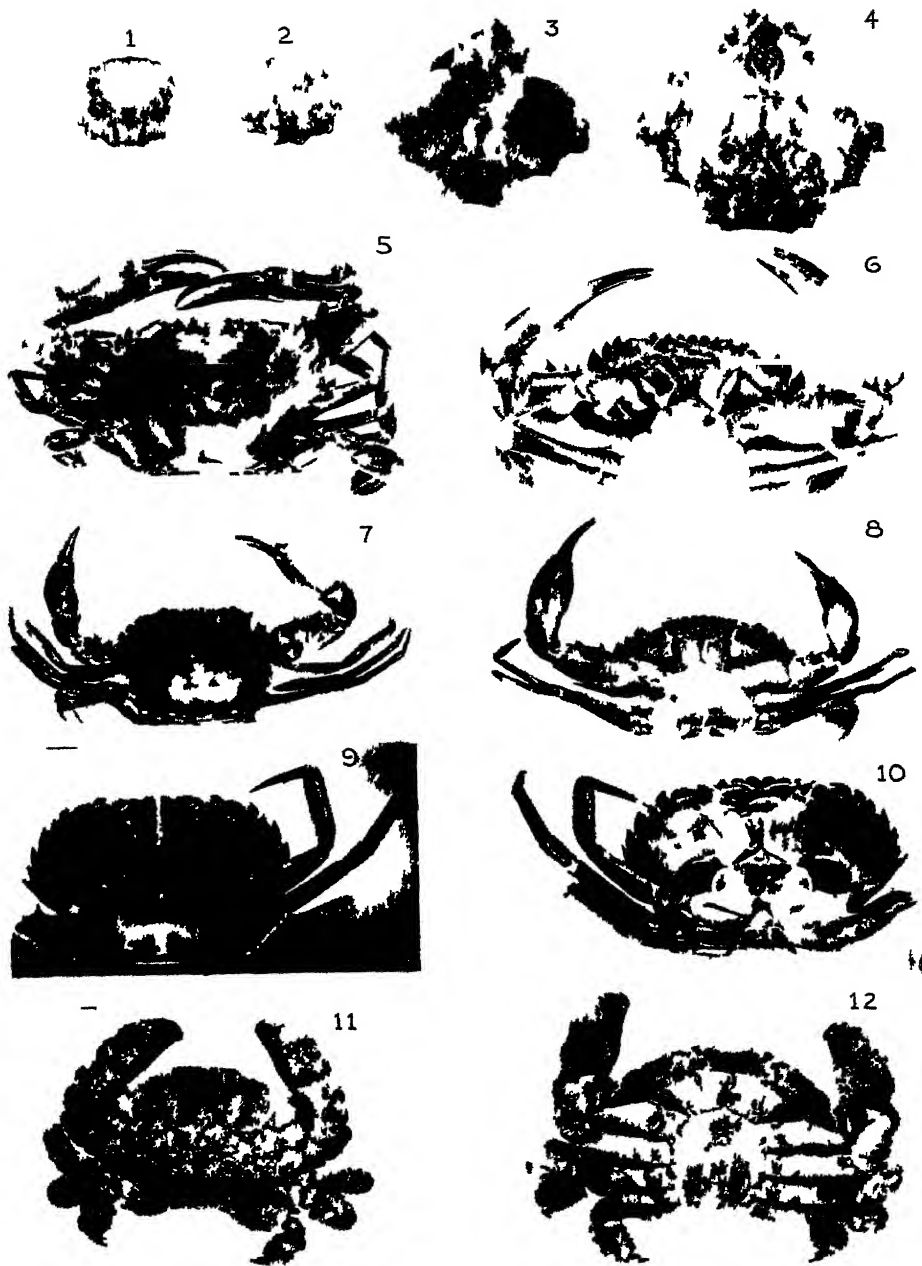
Charybdis padadiana, new species

Figures 9 and 10

Carapace broader than long, surfaces uneven, crossed by four ridges as in *C. vannamei* and *C. philippinensis*. The front is broader than in either of the previous species and is composed of six teeth, excluding the orbital angles the teeth are all short, broad and rounded. The anterolateral margins are armed with six teeth, the first two are blunt, the following three each capped by a spine, the second and fifth are the smallest. The posterolateral margins are thick with a line of granules which do not reach the posterior margin. The orbits are small, the upper margin with two closed fissures and one straight and narrow below the external angle. The orbital hiatus is broad and not completely filled by the prolongation of the base of the antenna. The lower orbital border is not visible throughout its length from a dorsal view; the inner angle is broad and obtuse and produced beyond the upper angle.

The epistome is sunken and broadly triangulate in outline; the apex divides the antennular fossae.

The external maxillipeds close the buccal orifice and the anterolateral angle of the merus is more auriculate than in the preceding species. The chelae are short and robust; the merus is armed with three large spines on the anterior margin; the carpus is armed with four spines, one on the inner angle, three in a triangle on the outer surface; strongly developed ridges extend onto each spine except the one which forms the apex of the triangle. The manus is armed with four spinate teeth above and three well-developed granular ridges on the outer surface. The dactylus and immovable finger are sulcated; teeth not very large and appear to be simple.



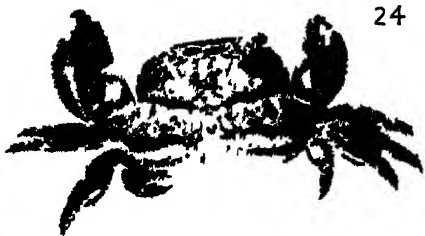
Figs 1 and 2 *Hete onucia oeschi* n sp holotype female 6 mm wide
 Figs 3 and 4 *Huena breifrons* n sp holotype female 10 mm wide
 Figs 5 and 6 *Charabydis iannameri* n sp holotype male 54 mm wide
 Figs 7 and 8 *Charabydis philippinensis* n sp holotype male 30 mm wide
 Figs 9 and 10 *Charabydis padadrana* n sp holotype female 17 mm wide
 Figs 11 and 12 *Ictaea paraspectiosa* n sp holotype male 12 mm wide



Figs 13 and 14 *Leptodius daraoensis* n sp holotype male 18 mm wide
 Figs 15 and 16 *Leptodius sanguineus philippinus* n subsp holotype male, 37.12 mm wide
 Figs 17 and 18 *Chlorodrella daraoensis* n sp holotype male 10 mm wide
 Figs 19 and 20 *Sphaeropsis orschi* n sp holotype female 17 mm wide
 Figs 21 and 22 *Ruppellwiesia philippinus* n sp holotype male 10 mm wide



23



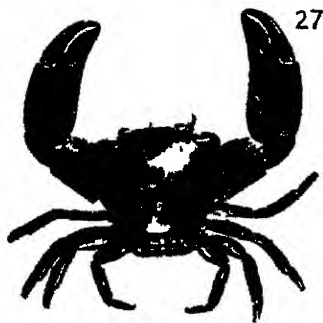
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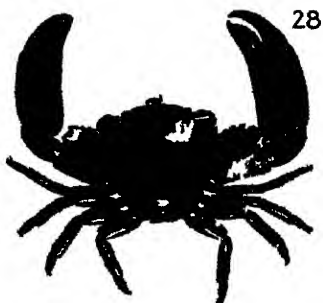
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Figs. 23 and 24. *Actumnus davaoensis*, n. sp.: holotype male, 10 mm. wide.

Figs. 25 and 26. *Eriphia pilumnoides*, n. sp.: holotype male, 23 mm. wide.

Fig. 27. *Trapezia davaoensis*, n. sp.: holotype, 8 mm. wide orig.

Fig. 28. *Trapezia plana*, n. sp.: holotype, 9 mm. wide.

Figs. 29 and 30. *Parapyridognathus deianira* (de Man): typical male, 12 mm. wide.

The walking legs are long, the distal articles are fringed with long hair. The sternum appears smooth but is finely granulated and punctate under a lens.

HOLOTYPE.—Female 17 mm. (Cat. No. A.M.N.H. 8381), collected by Godfred R. Oesch.

Charybdis padadiana is allied to *C. bimaculata* Miers and the following characters serve to distinguish the species:

- 1.—The eyes are comparatively smaller in *C. padadiana*.
- 2.—The front is broader and more produced anteriorly in *C. padadiana*.
- 3.—The inner angles of the lower orbital border are much more produced in *C. bimaculata* Miers.

Xanthidae

I have refrained from the division of Xanthidae into subfamilies owing to the unsatisfactory state of the classification.

ACTAEA DE HAAN

Actaea DE HAAN, 1833, in Siebold, Fauna Japon., Crust., pp. 4 and 18.

Actaea RATHBUN, 1930, Bull. 152, U. S. Nat. Mus. Washington, p. 250.

LOGOTYPE.—Specified by Rathbun, 1930. *Actaea savignyi* (H. M. Edwards) = *Actaea granulata* de Haan, 1833.

TYPE LOCALITY.—Red Sea.

Actaea rufopunctata philippinensis, new subspecies

The type locality of *A. rufopunctata* (H. M. Edwards) is Mauritius, and I have material from St. Brandon near Mauritius. The following characters serve to distinguish the subspecies:

- 1.—The areolations of the carapace are more salient in *A. rufopunctata*.
- 2.—The teeth of the anterolateral margins are more salient in *philippinensis*.
- 3.—The cardiac areolation is almost completely divided into two parts in *A. rufopunctata*.

MATERIAL.—One male 10 mm., holotype. One female 35 mm., collected by Godfred R. Oesch.

Actaea paraspeciosa, new species

Figures 11 and 12

The length of the carapace is equal to three-quarters of the width; flat posteriorly, convex anteriorly. The regions of the carapace are distinctly demarcated by deep sulci filled with hairs. The areolae are covered with pearly granules. The anterolateral margins are very

arcuate, divided into four rounded teeth. The posterolateral margin is shorter than the anterolateral, concave. The front-orbital region more than half the width of the carapace. Front divided into two lobes; the margins of which are invisible from a dorsal view. The orbits are small, eyes completely fill the orbit; the upper orbital border with two well-marked fissures. Lower orbital border broken near the outer angle by a deep fissure. Orbital hiatus narrow, the flagellum of the antenna stands in the hiatus. Antennules lie transversely in deep fossae. The epistome is sunken and smooth. The external maxillipeds are finely granulated.

The chelipeds are equal; upper and outer surfaces lobulated and granulated like the dorsum of the carapace. The ambulatory legs are short, thick and lobulated like the chelae. The sternum of the male is granulated. Adult females have the sternum covered by the abdomen.

A. paraspeciosa is allied to *A. speciosa* Dana, from Samoa, but can be distinguished by the following characters:

- 1.—All the granules are larger and more salient in *A. speciosa*.
- 2.—The inter-regional sulci of the carapace are wider, deeper and more clearly discernible in *A. speciosa*.
- 3.—The last segment of the abdomen of the male is larger in *A. paraspeciosa*.

A. speciosa Dana is found in Samoa while *A. paraspeciosa* occurs at Davao, New Britain, Samarai, Papua, and the Barrier Reef, Queensland.

In examining the collections in the Macleay Museum, Sydney, I found the original material of *Chlorodius perlatus* Macleay (= *Actaea perlata* Macleay) which was originally recorded from South Africa and although *A. paraspeciosa* bears a resemblance to *A. perlata* that species appears to be confined to the Western Pacific.

In the field I have observed *A. paraspeciosa* as a commensal upon the branches of living *Acropora* corals, sharing the habitat with *Trapezia* species and *Cymo* species.

MATERIAL.—Holotype, 12 mm. (Cat. No. A.M.N.H. 8356). Five males 9–13 mm., nine females 8–15 mm., collected by Godfred R. Oesch.

LEPTODIUS A. M. EDWARDS

Leptodius A. M. EDWARDS, 1863, Ann. Sci. Nat., (4) XX, p. 284.

LOGOTYPE.—*L. exaratus* (H. M. Edwards), 1834. Specified by Rathbun, 1930, Bull. 152, U. S. Nat. Mus., p. 296.

TYPE LOCALITY.—Coasts of India.

Leptodius davaoensis, new species

Figures 13 and 14

Carapace flattened, granulated microscopically and punctate. The areolations are strongly defined, those near the anterolateral margins, 1L, 2L, 3L, 4L, 5L, are developed into lobules.

The anterolateral are shorter than the posterolateral margins and are armed with five teeth, including the external orbital angle increasing in size posteriorly. There is a thick tomentose fringe just below the anterolateral margins and visible between the teeth of the margin. The front is declivous divided into two teeth, the outer of which are produced into small rounded teeth. The orbits are small with two fissures in the upper margin. There is a strong tooth below the outer angle which is prolonged beyond the angle. The lower orbital border is sinuous, the inner angle broadly triangulate and visible beyond the upper angle. The epistome is well developed and smooth. The sub-hepatic and pterygostomial regions close to the buccal orifice are devoid of tomentum.

The external maxillipeds are smooth and bare and completely close the buccal frame.

The chelipeds are unequal; the merus produced beyond the anterolateral margins of the carapace; the carpus is compressed, the upper surface is granulated, the granules forming irregularly anastomosing lines. There is a well-developed groove parallel and close to the articulation with manus; the inner angle is broadly triangulate and capped by a spinule. Manus compressed, longer than broad, the upper surface granulated, lower half smooth. The immobile finger is equal in length to the upper margin of the manus. The dactylus is slender and longer than the manus and armed with four teeth. The tips of both fingers are spoon excavate.

The ambulatory legs are slender; the merus smooth and fringed with tomentum, the distal articles are granulated upon the upper margins. The sternum of the male is smooth and shining.

Leptodius davaoensis is related to *L. australis* Ward but differs in having:

- 1.—The carapace flatter.
- 2.—The frontal lobes differently shaped.
- 3.—The chelae granulated.
- 4.—The hands shorter and more robust.
- 5.—The spinate process above the first anterolateral tooth of *L. australis* missing.

MATERIAL.—Holotype, male 18 mm. (Cat. No. A.M.N.H. 8347), forty-one males 9–18 mm., sixteen females 7–12 mm., collected by Godfred R. Oesch.

Leptodius sanguineus philippinensis, new subspecies

Figures 15 and 16

The typical form of *L. sanguineus* A. M. Edwards comes from Mauritius and, as I have material from the type locality, I have

been able to compare the Philippine material.

Leptodius sanguineus philippinensis differs from *L. sanguineus* in having:

- 1.—The lateral teeth of the front less produced and less acuminate.
- 2.—All the teeth in the vicinity of the orbits less acute.
- 3.—The orbital hiatus narrower, and the base of the antenna not extending into it as far as in *L. sanguineus*.
- 4.—The anterior margin of the merus of the external maxillipeds has a less deep cleft.
- 5.—The fingers of the chelae are shorter.
- 6.—The propodites and dactyli are less coarsely granulated.

MATERIAL.—Holotype, male 37 1/2 mm. (Cat. No. A.M.N.H. 8520), collected by Dr. Van Name. Four males 23–31 mm., collected by Godfred R. Oesch. Eight females 18–25 mm., collected by Dr. Van Name and Godfred R. Oesch.

Chlorodiella rathbun

Chlorodiella RATHBUN, 1897, Proc. Biol. Soc. Washington, II, p. 157; 1930, Bull. 52, U. S. Nat. Mus. Washington, p. 462.

LOGOTYPE.—*Chlorodiella niger* (Forsk.)

TYPE LOCALITY.—Red Sea. Specified by Rathbun, 1897.

The genus *Chlorodiella* is represented in the present collection by *Chlorodiella hirtipes* (Adams and White) of which there are sixty-four specimens, and by a second series of eighteen specimens which appear to be a new species and for which I suggest the name *Chlorodiella davaoensis*.

The material at my disposal enables me to suggest the following distribution of *Chlorodiella* species in the Indo-Pacific region:

- C. niger* Forskal, Red Sea.
- C. hirtipes* Adams and White, Philippine Islands.
- C. davaoensis*, new species, Philippine Islands.
- C. cytherea* Dana, Samoa, Fiji and perhaps the Hawaiian Islands.

Chlorodiella davaoensis, new species

Figures 17 and 18

Carapace smooth and glossy; regions indistinct; a few scattered punctations. Front formed of two broad rounded lobes strongly deflexed; a distinct cleft between the outer angle of the front and the orbital angle. The anterolateral margin armed with four unequal teeth of which the first is the smallest and fused with the

orbital angle; the second and third are subequal and widely separated, the fourth is small and placed close to the third. The posterolateral margins are longer than the anterior margins.

The eyes are large and fit snugly into the orbits, the upper orbital borders are raised and have traces of two sutures, a shallow V-shaped cleft just below the outer angle. The orbital hiatus is narrow and filled by the antenna. The sub-hepatic and pterygostomial regions are smooth and naked. The epistome is well developed, not sunken.

The external maxillipeds are smooth and completely fill the buccal frame. The chelipeds are unequal; the merus extends beyond the lateral margins of the carapace by a little more than half its length; there is a broad obtuse tooth near the proximal end of the anterior margin; carpus globose, the inner angle spinate. The upper border of the manus is equal to the width. The outer surface proximally wrinkled, the wrinkles transverse. Both fingers are curved so that they meet at the tips. Two teeth on the dactylus, one on the immobile finger. The smaller cheliped agrees with the large except that the manus is not as large and the fingers are less arched.

The ambulatory legs are slender, the tips of the dactyli are armed with two spines.

C. davaoensis differs from *C. hirtipes* in the following characters:

- 1.—The outline of the carapace which in *C. hirtipes* is more transverse.
- 2.—The anterolateral margins are more dentate in *davaoensis*.
- 3.—The anterior margin of the merus of the cheliped is armed with a curved acuminate spine in *C. hirtipes*.

MATERIAL.—Holotype, male 10 mm. (Cat. No. A.M.N.H. 8364), twelve males 7 to 10 mm., five females 6 to 10 mm.

CHLORODOPSIS A. M. EDWARDS

Chlorodopsis A. M. EDWARDS, 1873, Nouv. Arch. Mus. Hist. Nat. Paris, IX, p. 277.

LOGOTYPE.—*C. melanochirus* A. M. Edwards, 1873. Specified by Ward, 1932, Australian Zoologist, VII, III (Sept. 15), p. 250.

TYPE LOCALITY.—New Caledonia.

The following species are known to me by examination of specimens from the Indo-Pacific:

Chlorodopsis melanochirus A. M. Edwards. Barrier Reef, Queensland; Philippines.

Chlorodopsis melanodactylus A. M. Edwards. Barrier Reef, Queensland; Papua.

Chlorodopsis pilumnoides (Adams and White). Queensland (Mainland); Singapore; Philippines.

Chlorodopsis granulatus Stimpson. Singapore.

Chlorodopsis scabiuscula (Dana). Barrier Reef, Queensland.

Chlorodopsis pugil (Dana). Samoa; Philippines.

Chlorodopsis tenuis Rathbun. Barrier Reef, Queensland.

Chlorodopsis mitsi Waid. Queensland (Mainland).

Chlorodopsis philippinensis, new species

Carapace broader than long, flat posteriorly, convex anteriorly; distinctly areolated, inter-regional sulci, smooth and free of hair; the areolae are covered with light brown pubescence. The front is formed of two broad lobes, outer angles of which are produced into triangulate subacute teeth. The anterolateral margins are divided into four equal teeth not counting the external orbital angle; each tooth has large granules on its slopes. The posterolateral margins are slightly concave.

The orbits are large, the upper margins with two sutures. The epistome is well developed and clothed with pubescence. The sub-hepatic region is coated with pubescence. External maxillipeds are bare and polished.

The chelipeds are unequal, the merus extends beyond the margin of the carapace, the carpus is rugose and with spinose granules, the manus of the larger cheliped with rows of spinose granules on the upper surface, but becoming smooth on the lower and outer surfaces. The dactylus is equal in length to the upper margin of the manus; the immobile finger is punctate on the outer surface. The fingers are dark brown and the color extends back on to the palm.

The ambulatory legs are covered with pubescence and the distal articles are clothed with longer and thicker hairs.

The sternum of the male is smooth and bare.

MATERIAL.—Holotype, male 9 mm., six males 8 to 10 mm., four females 7 to 9 mm.

SPHAEROZIUS STIMPSON

Sphaerozius STIMPSON, 1858, Proc. Acad. Nat. Sci. Philadelphia (March), 35. BALSS, 1932, Zeitschr. f. wiss. Zool., CXLII, p. 512.

HAPLOTYP.—*S. nitidus* Stimpson.

TYPE LOCALITY.—Hongkong.

Sphaerozius oeschi, new species

Figures 19 and 20

Carapace wider than long, very convex longitudinally, less so transversely. The surface smooth and without indications of regions. The anterolateral margins arcuate, slightly shorter than the posterolateral margins and divided into four teeth, excluding the external orbital angle, the last two teeth are subacute and there is a short carina inward across the carapace from the apex of the last tooth; there is a well-developed smooth ridge extending just below the posterolateral margin from the base of the last antero-

lateral tooth to the epimeral margin of the carapace. A well-marked transverse groove extends close to the posterior margin of the carapace.

The front is declivous, divided into two teeth with very faint indication of an outer tooth on each side. The orbits are small, the margins raised, two closed sutures placed near the outer angle and one just below the outer angle. The orbital hiatus is narrow and filled by the flagellum of the antenna. The antennules are large and lie transversely. The epistome is small and sunken. The buccal orifice is broader than long and closed by the external maxillipeds. The external maxillipeds are smooth and devoid of hair. The sub-hepatic and pterygostomian regions are smooth and devoid of hair.

The chelipeds are very unequal in both sexes; the meius does not extend beyond the lateral margins of the carapace, the upper margin is strongly curved and sharply defined with a slight indentation near the distal extremity. The carpus is smooth and swollen externally, the inner angle bluntly produced. The manus is inflated and punctate on the outer surface and there is a well-marked groove extending along the external surface of the immobile finger and ending abruptly on a line with the articulation of the dactylus. The immobile finger is as long as the upper margin of the manus and is armed with a large proximal tooth. The dactylus is curved, punctate and with a single longitudinal groove on the outer surface close to the upper margin; the teeth are small and seven are quite separate; the proximal one is formed by three distinct cusps. The smaller chela agrees with the larger except in the details of the teeth on the fingers.

The ambulatory legs are unarmed, the distal articles have the margins sparsely clothed with stiff golden hairs.

The masculine abdomen is broad and extends as far as the first pair of ambulatory legs. In mature females the abdomen completely covers the sternum.

MATERIAL.—Holotype, female 17 mm. (Cat. No. A.M.N.H. 8368), nine males 8–13 mm., seventeen females 9 1/2–17 1/2 mm., collected by Godfred R. Oesch.

RUPPELLIOIDES A. M. EDWARDS

Ruppellioides A. M. EDWARDS, 1867, Sci. entom. France, (4) VI, p. 279.

HAPOTYPE.—*Ruppellioides convexus* A. M. Edwards.

TYPE LOCALITY.—New Zealand. (Not since recognized from the type locality, but known to me from the mainland of Queensland and Papua.)

***Ruppellioides philippinensis*, new species**

Figures 21 and 22

Carapace broader than long (11 by 16 mm., in the type), flat posteriorly and convex anteriorly.

The regions are outlined in the anterior half by the deep sulci; the posterior half is without sulci but is granulated. The anterolateral margins are convex and armed with five procurved teeth, the posterior slope of each tooth is carinate and granular. The posterolateral margins are slightly concave. The posterior margin is raised into a line of fine granules. The front is declivous and divided into four teeth by shallow grooves, the outer tooth is fused with the base of the antenna and there is a narrow orbital hiatus in which the antennal flagella stands. The orbits have a dorsal inclination, the upper border has faint traces of two fissures. The eyes fit snugly into the orbits. The antennules are transverse. The epistome is smooth. The anterior margins of the buccal frame are broken by the efferent branchial canals. The external maxillipeds completely close the buccal orifice. The merus is equal to half the length of the ischium and is coarsely granulated with the anterior margin deeply indented to correspond with the apertures of the buccal frame.

The chelae are markedly unequal. The merus is not visible beyond the margin of the carapace; the carpus is coarsely granulated and rugose. The manus is coarsely granulated on the outer upper surface, the granules diminish in size toward the lower border and fingers, the tips of the latter are perfectly smooth. The dactylus and immovable finger are armed with coarse teeth; there is a large pearl-like tooth at the base of the dactylus on the larger hand. The ambulatory legs are coarsely granulated. The sternal surface of the male is smooth with worn granules.

Ruppellioides philippinensis differs from *Ruppellioides convexus* A. M. Edwards in having:

- 1.—The fingers of the larger chelae longer and the large tooth longer.
- 2.—The last segment of the male abdomen longer.

Ruppellioides convexus A. M. Edwards is known to me from Lindeman Island, Bathurst Head, Queensland, and Port Moresby, Papua. In Australian seas the species is confined in its occurrence on the intertidal region to the thick incrusting layer of living oysters where it hides in tunnels beneath the oysters.

MATERIAL.—Holotype, male 10 mm. (Cat. No. A.M.N.H. 8352), six females 11–16 1/2 mm.

ACTUMNUS DANA

Actumnus DANA, 1851, Journ. Amer. Sci. and Arts., (2) XII, p. 128; 1852, U. S. Explor. Exped., Crust., I, p. 243.

LOGOTYPE.—*Actumnus tomentosus* Dana.

TYPE LOCALITY.—Samoa.

The following species of *Actumnus* are known to me by examination of specimens:

A. setifer de Haan, Japan; *A. squamosus* de Haan, Japan; *A. tomentosus* Dana, New Caledonia; *A. pupulator* A. M. Edwards, New Caledonia and Queensland. *A. tessellatus* Alcock, Arabia; *A. bonieri* Nobili, Arabia; *A. verrucosus* Henderson, Ceylon; *A. carinatus* Bouvier, Mauritius.

Actumnus davaoensis, new species

Figures 23 and 24

Carapace convex but not globose; areolations faint, surface granulate and covered with a fine coat of thin bristles, irregular in length and not obscuring the surface of the carapace. The front is almost equal to half the width of the carapace, divided into two broad, rounded teeth, the outer angles of which are produced into triangulate teeth. The anterolateral margins are thin and armed with four teeth, each capped with a spine except the external orbital angle. The posterolateral margins are almost straight though they converge rapidly toward the posterior margin. The orbits are large with traces of two fissures in the upper margin. The orbital hiatus is narrow and filled by the antenna. The epistome is smooth and slightly sunken. The sub-hepatic and pterygostomian regions appear smooth and covered with fine hairs. The external maxillipeds are finely granulated. The chelae are very unequal, the merus scarcely visible beyond the margin of the carapace; the external surface of the carpus of both chelae is smooth proximally, near the distal extremity granules and spinose granules appear. The external surface of both hands have longitudinal rows of well-separated spinose granules which appear sharper and more thickly placed on the smaller hand. The fingers are very short and the dactylus has a few spinules on the upper, proximal half.

The ambulatory legs are compressed, clothed with long golden hairs which do not impart a fringed appearance to the limbs. The sternal surface is smooth and clothed with similar hairs to those on the dorsum of the carapace.

HOLOTYPE.—Male 10 mm. (Cat. No. A.M.N.H. 8299), collected by Godfred R. Oesch.

A. davaoensis differs from *A. tomentosus* Dana in the following characters:

1.—The carapace of *A. tomentosus* is more transverse in outline so that the anterolateral margins form a strong curve away from the orbit; in *A. davaoensis* this margin is directed abruptly back from the orbit.

2.—The frontal teeth are rounded in *A. davaoensis* but in *A. tomentosus* they are truncated.

3.—The tomentum on the carapace of *A. tomentosus* imparts a velvety appearance, but the more scattered and bristle-like hairs of *A.*

davaoensis do not obscure the surface of the carapace.

4.—The fingers of the chelae are shorter and thicker in *A. davaoensis*.

ERIPHIA LATREILLE

Eriphia LATREILLE, 1817, Nouv. Dict. Hist. Nat., XX, p. 404.

HAPLOTYPE.—*E. spinifrons* (Herbst).

TYPE LOCALITY.—Adriatic.

The following species of *Eriphia* are known to me by examination of specimens:

Eriphia gonagra (Fabricius), Cuba; *Eriphia squamata* Balboa, Panama; *Eriphia spinifrons* (Herbst), Egypt; *Eriphia norfolcensis*, McCulloch; *Eriphia sebana* (Shaw), Singapore; *Eriphia scabricula* Dana, Fiji.

During an examination of the brachyuran collection in the Macleay Museum in the University of Sydney I found what appear to be the original specimens of *Eriphia fordii* Macleay and *Eriphia smithii* Macleay, both of which were originally described from South Africa.

Eriphia pilumnoides, new species

Figures 25 and 26

Carapace broader than long (15 by 23 mm., in the type), flat posteriorly, convex anteriorly; the regions are distinctly outlined by shallow sulci, surface entirely covered by forwardly directed coarse hairs. The anterolateral margin is strongly curved and armed with six procurved spines which diminish in size posteriorly. Posterolateral margins are slightly convex and without trace of a margin. The posterior margin is raised into a low ridge. The front is formed of two broad lobes, the median incision is broadly V-shaped, the outer angle of each lobe is rectangular. The orbits are large and set well into the dorsal surface of the carapace, supraorbital margin is raised and granulate with traces of two fissures. The lower border is thin and produced and armed with spinate granules which are large near the inner angle, a closed fissure is present just below the outer angle. The sub-orbital and sub-hepatic regions are coarsely granulated, especially near the antenna; the epistome is smooth and sunken. The anterior margin of the buccal frame is raised into a thin lamina broken on each side by the afferent branchial canals. The external maxillipeds completely close the buccal orifice. The maxillipeds are clothed with a shaggy coat of long hair. The chelae are unequal in size; the merus does not extend beyond the margin of the carapace; the carpus is convex and clothed with a thick coat of hairs. The manus is slightly longer than broad, the outer surface coarsely granulate and coated with shaggy hair except on the lower border which is bare and granulated. The fingers in both chelae are sulcate and finely granulate.

The ambulatory legs are slender, the distal articles sparsely clothed with stiff hairs.

The sternum of the male is bare and punctate.

HOLOTYPE.—Male 23 mm. (Cat. No. A.M.N.H. 8301).

ADDITIONAL MATERIAL.—Four males 19–22 mm., one female 23 mm., collected by Godfred R. Oesch.

Eriphia pilumnoides differs from *E. scabricula* Dana in the following characters:

- 1.—The carapace comparatively narrower.
- 2.—The bristles entirely cover the carapace.
- 3.—The abdomen of the male broader.
- 4.—The two lobes of the front are more developed and the median indentation deeper.

TRAPEZIA LATREILLE

Trapezia LATREILLE, 1825, Encyc. method, XX, p. 695.

LOGOTYPE.—*T. dentifrons* Latreille specified by E. Desmarest, 1858, in Chenu, Encyc. Hist. Nat., p. 18.

TYPE LOCALITY.—Red Sea.

I have examined large series of specimens of *Trapezia* from many parts of the Indo-Pacific and studied living material in tropical waters of the eastern Australian coast, Hawaii, Papua, Fiji and New Britain, but I am unable to follow Ortmann's classification (1897, Zool. Jahrb., X, pp. 201–216), there being considerably more species in existence than he allows.

It is interesting to record that during my examination of the Macleay museum collection of Brachyura I came upon the original specimens of *Trapezia subinteger* (Macleay), *Trapezia dentata* (Macleay), and *Trapezia maculata* (Macleay), all of which were originally described from Africa.

Trapezia davaoensis, new species

Figure 27

Carapace broader than long, scattered punctae over the whole surface but more numerous near the front. The anterolateral margins are thin but not lamellate and there is a procurved spine at the juncture of the antero- and posterolateral margins. The posterolateral margins are strongly convergent. The orbits are large and oblique, the outer angle produced into a strong spine; lower orbital border not strongly developed, entire and crescentic in outline; the inner angles are developed into broadly triangular teeth visible beyond the front from a dorsal view. The width of the front is equal to half the maximum carapace width; the teeth are not strongly developed. The antennae are not

within the orbital hiatus. The exopodites of the external maxillipeds are almost as broad as the endopodites; the merus is twice as long as the ischium and has the outer angle suborbiculate; there is a deep oblique longitudinal groove near the inner margin of the ischium. The merus of the cheliped has the anterior margin cut into six teeth the margins of which are granulated. The inner angle of the carpus is slightly produced and there is a broad tooth about half way between this angle and the articulation with the manus. The manus is punctate and has a mammiform swelling proximally on the dorsal surface; when flexed against the carpus, this swelling comes between the inner angle of the carpus and the broad tooth on its margin. The upper margin of the manus is thin but not carinate, the lower margin is thin and entire; there are some faint dark brown transverse lines extending from the upper margin, but these fade out before reaching a level with the gape.

The dactylus and immovable finger are equal in size; both are irregularly dentate. The ambulatory legs are slender; the distal articles with long hairs. A few large dark brown spots on the merus and carpus, two longitudinal lines of brown on the upper and two on the lower surface of the propodus. Dorsum of carapace creamy white with brown band across the front. Chelae reddish brown; legs similar but with spots and lines as noted.

HOLOTYPE.—Female 8 mm. (Cat. No. A.M.N.H. 8348).

ADDITIONAL MATERIAL.—Six males 5 to 8 mm., seven females 6 to 8 mm.

AFFINITIES.—*Trapezia davaoensis* is allied to *T. dentata* Macleay and *T. miersi*, new name, but differs from them in the following characters:

- 1.—The frontal teeth are less developed in *T. davaoensis*.
- 2.—The teeth of the front are more produced in *T. davaoensis*.
- 3.—The merus of the cheliped is longer in *T. miersi*.
- 4.—The fingers of the cheliped are longer in *T. miersi*.
- 5.—The external maxillipeds of *T. miersi* are without the longitudinal groove on the ischium

Trapezia plana, new species

Figure 28

Carapace wider than long, moderately convex, with few scattered punctae. Lateral margins are thin, not carinate, and with a blunt tooth instead of a spine at the juncture of the anterolateral and posterolateral margins. The orbits are large and oblique, the outer angle is blunt and not produced. The inner angle of the lower border only slightly visible beyond the front. The front is broad and produced but not deeply dentate.

The merus of the chelipeds is as broad as long, with the anterior margins cut into six truncated teeth; the carpus is small, the inner angle formed by a broad and blunt tooth; a second tooth of equal size lies between the angle and the articulation with the manus. The manus is densely punctate; the upper margin is thick and rounded; the lower margin is thin and lined with granules almost to the tip of the immovable finger. The dactylus is not as broad as the immovable finger; both are armed with well-developed teeth.

The ambulatory legs are not compressed; the distal articles have scattered long hairs and faint traces of pale brown spots. Coloration: Uniform pale yellowish brown, fingers of chelae darker.

HOLOTYPE.—Male 9 mm. (Cat. No. A.M.N.H. 8311).

ADDITIONAL MATERIAL.—Three males 7, 7.9 mm., one female 7 mm.

AFFINITIES.—*Trapezia plana* is allied to *T. subinteger* (Macleay) but can be readily distinguished by the following characters:

- 1.—In the form of the front.
- 2.—In the dentition of the merus of the cheliped.
- 3.—The presence of granules on the lower border of the manus of *T. plana*.
- 4.—In the regular development of the dentition of the fingers of the cheliped in *T. plana*.

Trapezia miersi, new name

Trapezia guttata MIER, 1888 (not Ruppell), Challenger, Zool. Brachyura, p. 166, from Fiji.

This species is known to me from Fiji and Papua.

Grapsidae

PARAPYXIDOGNATHUS, NEW GENUS

Pyxidognathus A. M. Edwards was originally erected for a single species, *P. granulosus* A. M. Edwards, from Fiji. I have examined a fine male from a fresh or brackish water stream in Fiji, which is housed in the Macleay Museum, Sydney.

Parapyxidognathus differs from *Pyxidognathus* in having:

- 1.—The carapace comparatively broader.
- 2.—The front not produced.
- 3.—The exopodite of the maxillipeds broader.
- 4.—The chelae are extremely unequal in size.
- 5.—The ambulatory legs longer.

Parapyxidognathus deianira (de Man)

Figures 29 and 30

Pyxidognathus deianira DE MAN, 1888, Journ. Linn. Soc. London. XXII, p. 148, Pl. xx, figs. 4-6

MATERIAL.—Eighty-seven males 4 to 12 mm., seventy females 4 to 10 mm., collected by Godfred R. Oesch.

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TERRESTRIAL FLATWORMS FROM THE CANAL ZONE, PANAMA

BY LIBBIE H. HYMAN

The material of this report consists of about twenty vials of terrestrial flatworms collected on Barro Colorado Island, Canal Zone, by Mr. E. C. Williams, Jr., of Northwestern University, and one land planarian from Tabernilla, Canal Zone, lent for study by the U. S. National Museum. All of the specimens except the last, whose habitat was not stated on the label, came from the forest floor. Unfortunately some of the specimens are juvenile and hence a full description of them cannot be furnished. There were identified in the material one prorrhynchid alloecocoel, three species of *Geoplana*, and two rhynchodemids.

New species described in this article:

Family Prorrhynchidae
Geocentrophora tropica
Family Geoplanidae

Geoplana panamensis
Geoplana aphalla
Family Rhynchodemidae
Diporodermus plenius
Desmorhynchus angustus

Information concerning the terrestrial flatworms of this region of the Americas is scanty. The most important contribution is Fuhrmann's report on the land planarians of Colombia (1914). Other articles are two papers by de Beauchamp (1912, 1913), describing one prorrhynchid and three land planarians from the water held by Bromeliaceae in Costa Rica, and two papers by myself (Hyman, 1938, 1939), containing descriptions of land planarians from Mexico and Costa Rica. Several geoplanids from Colombia and Venezuela are described in von Graff's monograph of the land planarians (1899).

ORDER ALLOEOCOELA

PRORHYNCHIDAE

GEOCENTROPHORA DE MAN, 1876

Geocentrophora tropica, new species

Figures 1 to 4

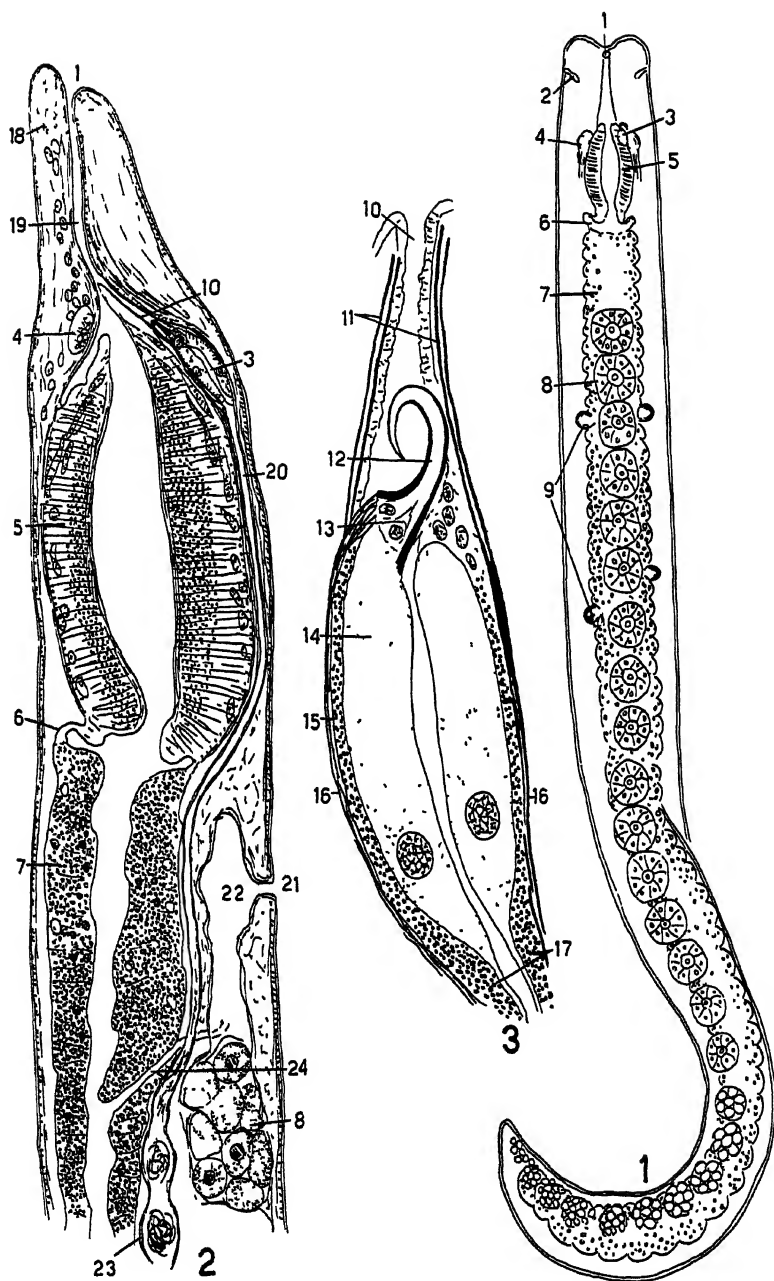
MATERIAL.—Five vials in Williams' collection, Nos. 215, 364, 768, 1124, 1299. 216 and 1350, which were lost, were probably also this species.

EXTERNAL CHARACTERS.—Long and slender, flattened, band-like, to 5 mm. in length; sides parallel through anterior body half, then tapering to posterior end (Fig. 1). Anterior end with rounded sides and central depression marking position of mouth; mouth slightly subterminal (Fig. 2). Eyes wanting; pair of deep narrow ciliated pits near anterior end at sides, opening slightly ventrally (Fig. 1). Female genital pore close behind rear end of pharynx (Fig. 2). Transverse section (Fig. 4) elongated oval, with central bulge caused by ovary. Color black, contrary to all other prorrhynchids, which are white.

GENERAL HISTOLOGY.—Surface epithelium devoid of nuclei, cell walls, and rhabdites; has

fibrous appearance and is crossed by numerous gland outlets; is dark colored but definite pigment granules cannot be discerned. Epithelium heavily ciliated ventrally but devoid of cilia dorsally. Epithelium bounded internally by definite basement membrane immediately internal to which is the subepidermal musculature of outer thin circular and inner thick longitudinal layers (Fig. 4). Immediately to the inner side of the longitudinal layer is another thin circular layer (Fig. 4), best developed dorsally; but another longitudinal layer to the inner side of this found in some prorrhynchids is wanting in *G. tropica*. Nuclei are first encountered in the parenchyma inclosed by the muscle layers; they are very large and conspicuous, filled with coarse granules.

Three kinds of gland cells noticed. First kind (Fig. 4, a), sparingly present in mid-dorsal region of anterior end, is long, slender, tortuous, only slightly eosinophilous; some open as frontal glands on anterior tip above mouth (Fig. 2); others open dorsally in anterior part of body. Second kind, very abundant in dorso-lateral body regions throughout body length, also sparingly present ventrally, have a



Geocentrophora tropica

Fig. 1. General form and gonads. Fig. 2. Median sagittal section through the anterior end, showing pharynx, male system, female pore, and genito-intestinal duct. Fig. 3. Sagittal section of male copulatory apparatus showing histological details.

large body filled with a network staining with haematoxylin, and a narrow neck opening through the epidermis (Fig. 4, b). These glands seemingly take the place of rhabdites. Third type of gland (Fig. 4, c), found in ventro-lateral body regions, is eosinophilous, filled with granules; apparently does not open on the surface.

Parenchyma, in addition to gland cells and nuclei mentioned above, contains dorso-ventral muscle fibers and large cells of indeterminate nature (Fig. 4).

DIGESTIVE TRACT.—Typical of the family. Slightly subterminal mouth (Fig. 2) leads into moderately elongated buccal tube which, just before widening into the pharynx, receives the male canal. Pharynx elongate, of the type termed *bulbosus variabilis intextus*, i.e., the muscle layers of inner and outer surfaces have the same orientation. Pharynx lined by a structureless membrane without nuclei or cell walls, underlain by a well-marked layer of longitudinal muscle fibers, followed to its outer side by a thick layer of circular fibers, interspersed between the radial fibers (Fig. 2). This is followed by a zone of nuclei and gland cells, to the outer side of which is a thin coat of circular, then longitudinal fibers. Numerous radial fibers course from inner to outer surfaces of pharynx. Gland cells are cyanophilous, open near free end of pharynx. Pharynx is followed by very short esophagus (Fig. 2), opening at once into long tubular slightly scalloped intestine, composed of large columnar cells, packed with spherules, representing digesting or digested food (Fig. 2). Intestine extends nearly to posterior tip (Fig. 1).

NERVOUS SYSTEM AND CILIATED PITS.—Material does not suffice for a thorough study of the nervous system and hence only a few comparisons will be made with Steinböck's figure of the nervous system of *G. baltica* (1927). Conspicuous brain of paired lateral masses connected by broad dorsal commissure above anterior tip of pharynx. Main mass of each ganglion gives off anteriorly large trunk, the main dorsal sensory nerve, which extends to anterior tip joining an extensive plexus there; ventrally each ganglion gives off a similar ventral sensory nerve which runs forward into the same plexus. From the dorsal side of each ganglion, the small dorsal nerve takes its origin, and extends both anteriorly and posteriorly throughout the body length. Extreme ventral end of each ganglion gives off the main ventral nerve trunk of that side, which turns backward and runs to the posterior end. Both ventral and dorsal nerves can be seen in cross-sections of the body. Steinböck also figures ventro-lateral and dorso-lateral trunks along the whole body length but these could not be clearly seen in my material, although I do not doubt their presence. The nervous system of *G. tropica* is thus very similar to that of *G. baltica* but the dorsal and ventral anterior sensory nerves are much more massive than figured by Steinböck

for *G. baltica* and the dorso-lateral and ventro-lateral trunks appear to be less developed than in the latter species.

The bases of the ciliated pits lie close to the dorsal sensory nerves from which they obtain a generous nerve supply. Each pit has the shape of a florentine flask with narrow neck and expanded round basal chamber. Steinböck (1927) has given detailed descriptions and figures of the ciliated pits of several prorhynchid species and Kepner and Taliaferro (1916) described those of a form which they called *Prorhynchus applanatus*.

The ciliated pits of *G. tropica* closely resemble Steinböck's figure of those of *G. baltica* except that the end chamber is larger in *tropica*. The neck is lined by a heavily ciliated syncytial epithelium containing three nuclei on each side. The rounded end chamber consists of the same syncytial epithelium, without nuclei, bearing stiff rod-like cilia, probably sensory bristles, and penetrated by the necks of numerous gland cells. The end chamber is embraced by nervous tissue coming from the adjacent dorsal sensory nerve; this nervous mass was mistakenly regarded by Kepner and Taliaferro as a "gland cell." The numerous dark granules in the nervous mass are cross-sections of the necks of the elongated gland cells. The mistake of Kepner and Taliaferro was already noted by Steinböck. The gland cells supplying the end chamber are similar to the first type described above.

REPRODUCTIVE SYSTEM.—Typical of the genus. All specimens were sexually mature. Testes very few in number, apparently only one pair in the smaller specimens; these form a pair of small sacs not far posterior to the level of the female pore (Fig. 1). Larger specimens have another pair of testes behind the first pair (Fig. 1) but I have found no certain evidence of more than two pairs. Other known species of *Geocentrophora* have 6-14 pairs of testis follicles. Male duct as in other members of the genus (Fig. 2); vas deferens expands into elongate seminal vesicle at level of anterior end of ovary; from this duct runs forward immediately below pharynx and enters male copulatory apparatus (Fig. 3), an elongate body provided with a hard curved stylet. This lies just beneath the anterior end of the pharynx. The male copulatory apparatus of *G. baltica* has been carefully described by Steinböck and that of *G. tropica* is very similar. It differs chiefly in that the lining epithelium consists of about four very elongate cells (Fig. 3) whereas in *G. baltica* the lining is a multinucleate syncytium. Outside the epithelium is a coat of circular muscles, thickened to a sphincter at the proximal end of the apparatus and outside this are longitudinal muscle bands. On the dorsal side some of the latter insert on the base of the stylet while others run alongside the penis pocket. Ventrally the muscle bands run forward along the penis pocket as protractors and backward as retractors. The stylet is a hard curved spine whose base attached to the dorsal side of the apparatus, contains two cells, apparently secretory cells of

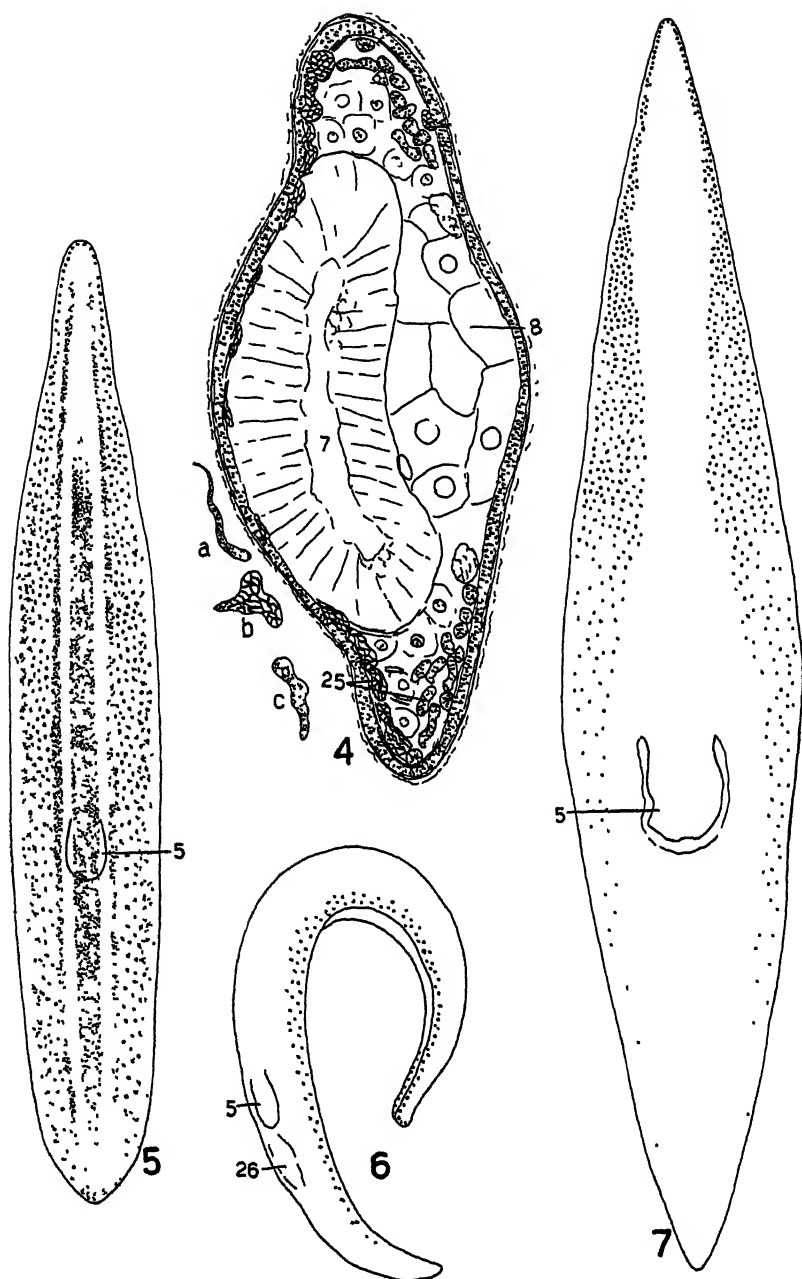


Fig. 4. Transverse section of *Geocentrophora tropica*; to the left the three types of gland cells enlarged (a, b, c).

Fig. 5. *Geoplana panamensis*, showing distribution of eyes and color pattern.

Fig. 6. *Geoplana aphalla*, showing eye arrangement.

Fig. 7. *Geoplana cameliae*, showing shape and eye arrangement.

the stylet. In the opposite wall is a cluster of nuclei. Beyond the stylet the male canal continues as the penis pocket which opens into the buccal tube just in front of the anterior end of the pharynx.

The single female sex gland is alike in all known prorhynchids. It is really a germovitelarium and extends from the posterior end of the body forward in midventral position below the intestine (Fig. 4) to the level of the seminal vesicle. The youngest part of the gland is at the posterior end where it consists of clusters of like cells. As one proceeds anteriorly this breaks up into follicles or egg balls, each of which consists of a central ovocyte and a peripheral layer of follicle cells, corresponding to the yolk cells of other Turbellaria (Fig. 1). These egg balls and the contained ovocyte increase in size anteriorly so that the largest is nearest the female pore. Anterior to the terminal egg ball, there is an elongated chamber, the female antrum, which opens ventrally in the median line by the female genital pore (Fig. 2).

The usual genito-intestinal canal is present (Fig. 2), extending from the lumen of the intestine through the thick epithelium of the latter, passing in front of seminal vesicle, to one side of the male duct, and entering the rear end of the female antrum, just in front of the terminal egg ball.

DIFFERENTIAL DIAGNOSIS.—*G. tropica* differs from all other known species of the genus except *G. baltica* in its elongated, band-like shape; it differs from *G. baltica* in its black color, details of the male copulatory apparatus, lack of anteriorly projecting intestinal diverticulum above the rear end of the pharynx, more posterior position of male copulatory apparatus and its connection with the buccal tube, and fewer number of testis follicles.

REMARKS.—There were previously reported from the American continents three prorhynchid species: *Prorhynchus stagnalis* M. Schultze, 1851, *P. applanatus* Kennel, 1888, and *P. metameroide* de Beauchamp, 1913. *P. stagnalis* is cosmo-

politan and is well known to occur in the eastern United States. I have several times collected specimens in streams and ponds near Yonkers, N. Y. One sexually mature was found in November, 1939, and sectioned; study of the sections showed that it is indeed identical with European specimens. *P. applanatus* was described from Trinidad. Kepner and Taliaferro (1916) applied this name to a prorhynchid which they found in the vicinity of the University of Virginia. I am in agreement with Steinböck that their identification is very doubtful; in all probability they had an undescribed species. However, I have collected near Yonkers specimens that correspond in every detail with Kennel's description and I do not doubt that they were *P. applanatus*. I also failed to see any male organs in pressed live specimens but unfortunately I did not section any of the specimens. *P. metameroide* was described by Beauchamp from water collected in the leaf bases of Bromeliaceae in Costa Rica. There does not seem to be any possibility that it could be identical with the present species. Steinböck is of the opinion that both *applanatus* and *metameroide* belong to the genus *Geocentrophora* but as the male apparatus is not known for either and as this apparatus constitutes the distinction between *Prorhynchus* and *Geocentrophora*, the grounds of his decision appear inadequate, consisting merely of the external similarity to *G. sphyrocephala*.

COTYPES.—Three specimens mounted whole on slide. A.M.N.H. Cat. No. 283.

ORDER TRICLADIDA

GEOPLANIDAE

GEOPLANA STIMPSON, 1857

Geoplana cameliae Fuhrmann, 1914

Figures 7 to 9

MATERIAL.—Two juvenile specimens in Williams' collection, vial No. 1015; one specimen in early sexuality, lent by U. S. National Museum.

EXTERNAL CHARACTERS.—A large species, reaching a length (preserved) of 50 mm., and a width of 5 mm. according to Fuhrmann (1914); the largest specimen available to me was 33 mm.

long and was only at the beginning of sexual development. Form (Figs. 7, 9) typically geoplanid; anterior end narrow; body quickly widening to broad flat shape, broadest at the level of the pharynx, then decreasing to the bluntly pointed posterior end. Relative positions of mouth and genital pore shown in Fig. 9. Eyes numerous (Fig. 7) in single file around the anterior end, soon widening to a broad band several eyes deep, extending about one-third the body width; this greatest breadth of the eyes is reached at about the anterior third of the body; from there the band decreases in width to the level of the pharynx; from the pharynx to the

posterior end, the band consists of few scattered eyes. Color (Figs. 8, 9) consists of a black mottling on a dark brown ground and corresponds entirely to Fuhrmann's description. In all three specimens, as also in Fuhrmann's description, there is a tendency to a light mid-dorsal band, caused by the absence of black pigment here so that the ground color shows. This band is unequally developed in the three specimens and in any case is evident only on the middle part of the worm, fading away toward the ends (Fig. 9).

COPULATORY APPARATUS.—Unfortunately none of the available specimens was sexually mature. The sexual region of the U. S. National Museum specimen was sectioned and although this specimen had an obvious genital pore, the copulatory apparatus was only partially developed. In so far as the development had proceeded, the apparatus was in agreement with Fuhrmann's figure (Fig. 4, p. 758), so that the identification is reasonably certain.

SPECIMEN.—One whole mount deposited in A.M.N.H. Cat. No. 284.

REMARKS.—This species must be fairly common throughout a considerable geographical range, since Fuhrmann took 20 specimens in the central mountains of Colombia, at 1400–1800 meters' altitude, and 3 specimens have been taken in the Canal Zone. I am also of the opinion that *Geoplana plana* Schirch, 1929, from Teresopolis, Brazil, is identical with *Geoplana cameliae*. Riester, 1938, had a land planarian 110 mm. long in life, which he assigned to *G. plana* and gives a colored figure which closely resembles my specimens. Neither Schirch nor Riester describe the arrangement of the eyes or the copulatory apparatus so that the synonymy must remain uncertain at present. Apparently neither author was aware of Fuhrmann's work on the land planarians of Colombia.

Geoplana panamensis, new species

Figure 5

MATERIAL.—Three vials, each with one specimen, Nos. 1175, 1368, 1387, juvenile.

EXTERNAL CHARACTERS.—Shape typically geoplanid, anterior end narrow, quickly widening to flattened body; available specimens to 12 mm. in length but as they are juvenile with no trace of sex organs, the size at maturity must be considerably greater. Eyes numerous, similar in arrangement to that of the preceding species, forming a single file around the anterior end; this soon widens to a band four or five eyes deep occupying the region between the lateral stripe and the margin (Fig. 5); eyes decrease in number

and become more scattered in posterior body half. Color pattern consists of three black stripes on a brown ground. The median stripe is broad and dies out some distance from the anterior tip. To either side of this is a narrow lateral stripe which continues forward onto the head. From the lateral stripe the black pigment again increases toward the margins which are quite dark but do not bear a definite stripe. Ventral surface drab.

DIFFERENTIAL DIAGNOSIS.—This species is recognizable by the combination of eye arrangement and color pattern.

REMARKS.—In the absence of sexual material, it is not possible to furnish an adequate description of this species. In general it is not desirable to base new species of land planarians on external characters only, because of the large number of species already described. However, the color pattern and eye arrangement of this species are so distinctive that a description seems justifiable.

TYPE.—One whole mount (No. 1368), A.M.N.H. Cat. No. 285.

Geoplana aphalla, new species

Figures 6, 10

MATERIAL.—One specimen, sexually mature, vial No. 208.

EXTERNAL CHARACTERS.—A small species, length of mature specimen about 5 mm., anterior end blunt, posterior slightly pointed, body thin and flat (Fig. 6); curvature due to preservation prevented getting exact idea of shape. Eyes moderately numerous in band along body margin, arranged in single file around the anterior end, widening to about anterior third where the band of eyes is about three eyes deep; thence declining and dying away toward the posterior end. Color uniformly black above, consisting of a fine black granulation on a dark brown ground. Position of pharynx and copulatory apparatus shown in Fig. 6.

COPULATORY APPARATUS.—The specimen was cut into serial sections and although in bad condition because of accidental drying nevertheless permits the sexual apparatus to be studied. Copulatory apparatus shown in sagittal section in Fig. 10. Male apparatus lacks definite penis papilla; consists of elongated chamber with greatly folded walls receiving two vasa deferentia at its anterior end; a slightly muscular tissue incloses the apparatus. Female apparatus also consists of chamber with irregularly folded walls; from postero-dorsal angle of this glandular duct extends posteriorly and receives oviduct encircled by cement glands. The epithelium of the entire female chamber and glandular duct is very glandular filled with secretion granules. Tubular canal leads from copulatory apparatus to genital pore.

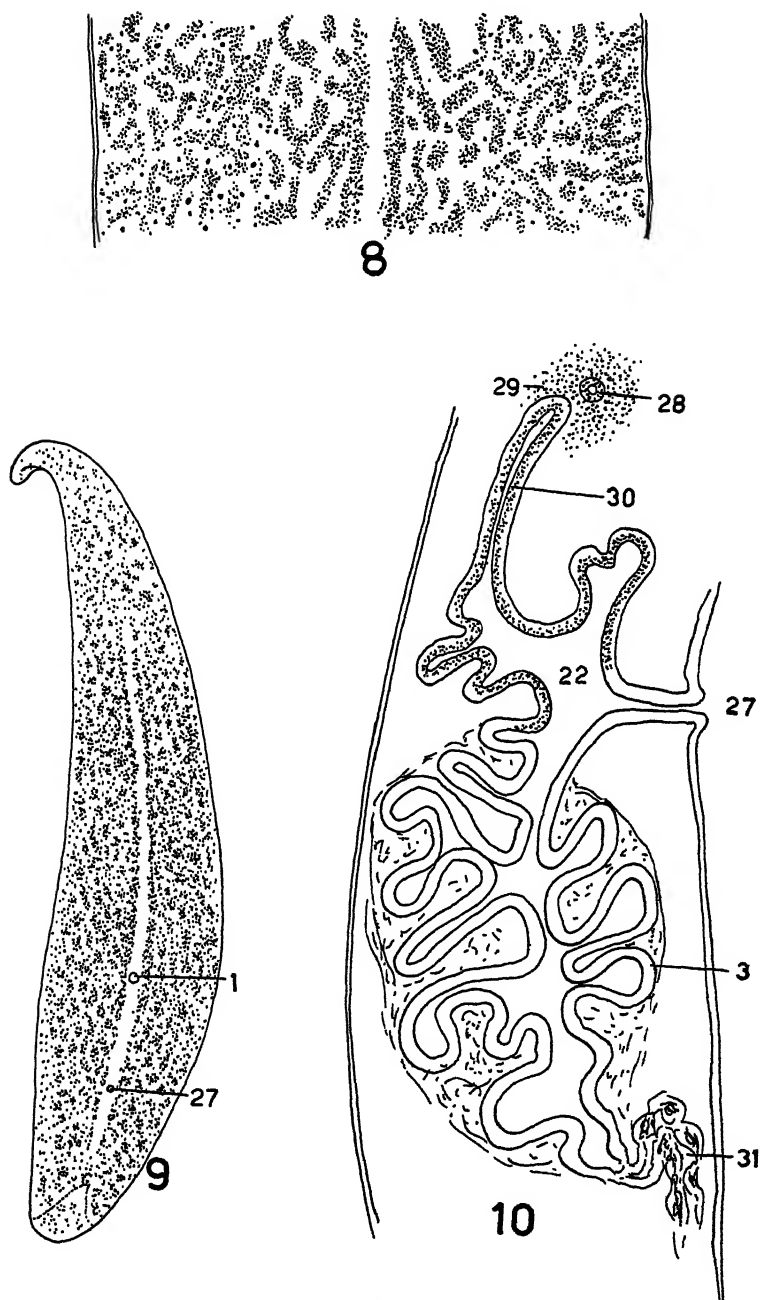


Fig. 8. Enlarged view of color pattern of *Geoplana cameliae*.

Fig. 9. Largest available specimen of *Geoplana cameliae*, showing general color pattern, and location of mouth and genital pore.

Fig. 10. Sagittal section of the copulatory apparatus of *Geoplana aphalla*.

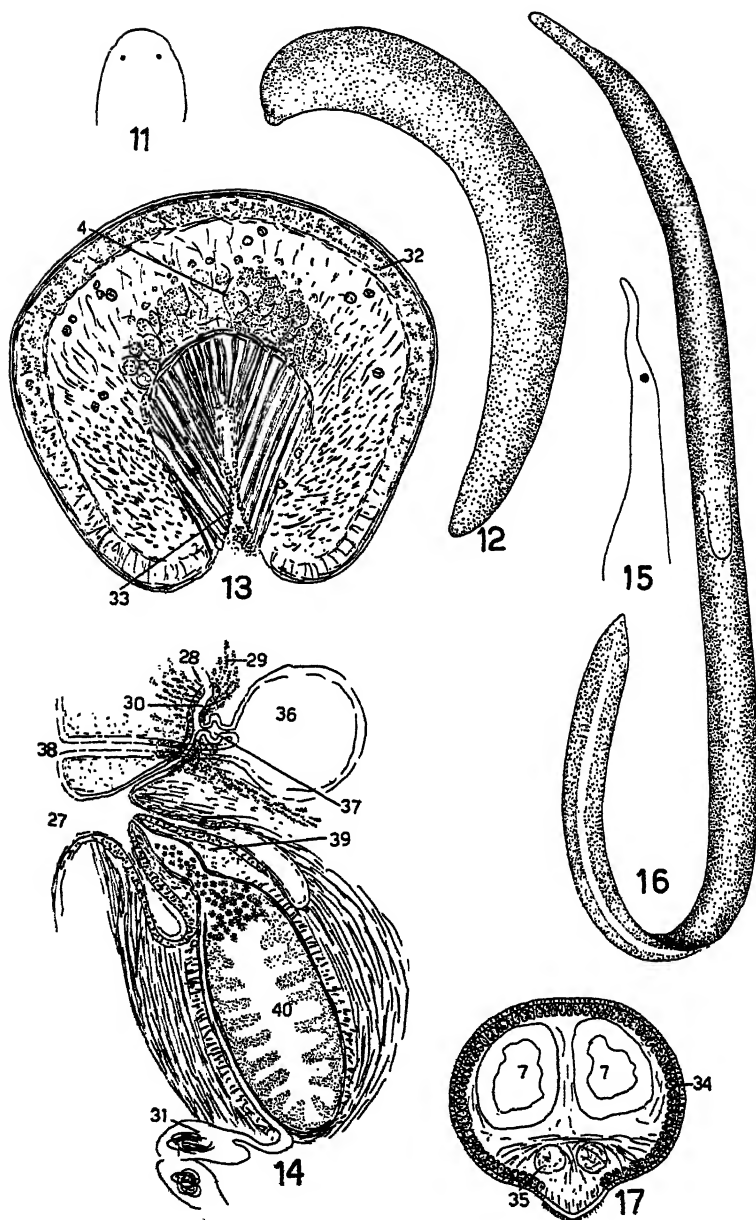
*Diporodemus plenus*

Fig. 11. Head. Fig. 12. Shape. Fig. 13. Cross-section, through head, showing the glandulo-muscular organ. Fig. 14. Sagittal section of the copulatory complex.

Desmorhynchus angustus

Fig. 15. Anterior end. Fig. 16. View of entire animal. Fig. 17. Cross-section through body, showing layer of longitudinal muscle bundles.

DIFFERENTIAL DIAGNOSIS.—This species is distinguished by the combination of small size, black color, and details of the copulatory apparatus.

REMARKS.—There appear to be a large number of species of *Geoplana* in which a penis papilla is lacking and the male apparatus consists simply of a chamber with folded walls. Riester figures a number of such male apparatuses in his work on Brazilian *Geoplanas*. It is probable, however, that the folds of the wall may be so manipulated during erection as to form a functional penis papilla. I have shown that this is the case in *Rhynchodemus atropurpureus* (Graff) 1899 where one specimen showed a male copulatory apparatus like that of *G. aphalla* and another has a penis papilla formed by erection of the folds adjacent to the entrance of the vas deferens (Hyman, 1940).

TYPE.—One set of serial sections. A.M. N.H. Cat. No. 286.

RHYNCHODEMIDAE

Rhynchodeminae Heinzel, 1929

DIPORODEMUS HYMAN, 1938

Diporodemus plenus, new species

Figures 11 to 14

MATERIAL.—One specimen, No. 357, sexually mature.

EXTERNAL CHARACTERS.—Plump, cylindroid (Fig. 12), about 15 mm. long; slight indentation near anterior tip; eyes small, two, near anterior tip, shortly behind level of indentation (Fig. 11); color uniform brownish black above shading to a lighter yellowish brown tone below; midventral line with white ridge, formed by the creeping sole.

CROSS-SECTION.—Anterior end sectioned transversely, posterior half containing copulatory apparatus sectioned sagittally. As the genera of the Rhynchodemidae cannot be distinguished without study of the arrangement of the musculature, transverse sections are essential. Transverse sections through the body are approximately circular. Epidermis of low columnar form; beneath epidermis thin layer of circular fibers followed by very thin layer of longitudinal fibers; next comes a wide zone containing abundant pigment granules and rhabdite-forming cells; internal to this is an equally wide zone of muscle fibers, chiefly diagonal. This inner muscle zone incloses the intestine and nerve cords. The absence of a strong subepidermal longitudinal muscle layer arranged in bundles places the animal in the subfamily Rhynchodeminae, and the structure of the copulatory apparatus indicates the genus *Diporodemus*.

Cross-sections through the head show an absence of the ciliated grooves found in *D. yucatani*, the only other species of the genus. However, on the ventral surface of the head, beginning shortly behind the eyes and extending posteriorly for a brief distance there is a glandulo-muscular depression (Fig. 13). The regular epidermis ceases at the borders of the depression, the lining of which is of indefinite nature. The depression has the form of a longitudinal cleft to which strong bundles of muscle fibers run from a bounding muscular stratum. Gland cells run among the muscle bundles and open into the cleft, which contains a mass of glandular material. The gland cells supplying the depression extend some distance posterior to its level as paired groups lying just above the ventral nerve cords. These groups of gland cells lie behind the level of the section illustrated in Fig. 13. This section also does not show the strong muscle zone to the inner side of the pigment zone, as this gradually appears in more posterior sections. The masses of diagonal muscles to either side of the depression (Fig. 13) become continuous with this muscle zone. The glandulo-muscular depression of *D. plenus* is apparently some form of adhesive organ.

COPULATORY APPARATUS.—Closely resembles that of *D. yucatani* Hyman, 1938. Penis large, muscular, with well-developed papilla, and elongate muscular bulb. Penis bulb with thick outer layer of lengthwise muscle fibers, internal to this layer of circular fibers, then a thin stratum of longitudinal fibers next the lining epithelium (Fig. 14). Muscle layer very thin over anterior end of penis bulb. Common vas deferens enters from below anterior end of penis bulb, then courses backward inside the inner longitudinal muscle layer, ventrally, just beneath the lining epithelium, to base of penis papilla where it opens into lumen (Fig. 14). Penis papilla moderately muscular, with longitudinal layer next to lining and thick layer of transverse fibers in outer wall. Lining of penis bulb and penis papilla consists of very glandular epithelium, more or less disintegrated in the specimen; appeared to be much folded in penis bulb. Distal end of lumen of penis bulb and lumen of penis papilla filled with rounded eosinophilous masses of secretion. Common genital pore large; fold descends from dorsal wall between male atrium housing the penis papilla and female canal. Latter opens into posterior wall of common genital atrium, slants dorso-posteriorly and continues as short glandular duct into whose posterior end oviducts open. Glandular duct receives along its course numerous eosinophilous cement glands, and gives off a short Beauchamp's canal connecting it with the seminal bursa. The latter is a large sac, lined by a tall epithelium, but without any definite muscular layers outside the epithelium. Just in front of the entrance of Beauchamp's canal, its ventral surface narrows into a stalk; the bursa stalk, which proceeds directly to the ventral surface and opens there by a special female pore, the vaginal pore, shortly

behind the normal common genital pore. This opening of the bursa on the ventral surface is diagnostic of the genus *Diporodemus*. As in *D. yucatani*, the common genital pore opens in the midventral line, in the creeping sole, but the vaginal pore opens laterally, to one side of the sole.

DIFFERENTIAL DIAGNOSIS.—*D. plenus* differs from *D. yucatani*, the only other member of the genus, in the presence of a glandulo-muscular adhesive organ on the ventral surface of the head, absence of cephalic ciliated grooves, in the histology of the penis, absence of muscular coat on the seminal bursa, and proximity of the vaginal pore to the common genital pore.

REMARKS.—In 1938, I founded the genus *Diporodemus* on two specimens collected in Yucatan, Mexico. It is interesting to find another species of the genus, practically identical in external appearance, in a locality not far removed from the type locality.

TYPE.—One specimen, anterior end as transverse serial sections, posterior half as sagittal serial sections, remainder of body as piece left in original vial. A.M.N.H. Cat. No. 287.

Desmorhynchinae Heinzel, 1929

DESMORHYNCHUS HEINZEL, 1929

Desmorhynchus angustus, new species

Figures 15 to 17

MATERIAL.—Four vials, each with 1–3 specimens, Nos. 1016, 1105, 1206, 1385, all juvenile; Nos. 190, 647, 847, probably also are this species.

EXTERNAL CHARACTERS.—Long and slender, to 30 mm. long, cylindroid, cross-section (Fig. 17) broadly oval, dorsally flattened. Anterior end with a pair of large eyes (Fig. 15); head anterior to eyes remarkably long and flat, somewhat wavy. Shortly behind level of eyes, the body quickly becomes plump (Fig. 15), continues of about the same diameter to near posterior end which tapers slightly (Fig. 16). Color uniformly black above, shading to lighter grayish drab hue below. Median ventral line with white ridge of creeping sole. Position of pharynx shown in Fig. 16.

CROSS-SECTION.—Shows that the animal belongs to the genus *Desmorhynchus* as beneath the epidermis there is a thick stratum of longitudinal muscle bundles. These bundles appear in cross-sections as closely placed oval masses immediately internal to the thin layer of circular

muscles next the epidermis (Fig. 17). There are no other noteworthy features of the cross-section.

DIFFERENTIAL DIAGNOSIS.—In the absence of sexual material, diagnosis rests on the black color, long slender shape, large eyes, elongated head anterior to the eyes.

REMARKS.—Of a number of rhynchodemid species transferred by Heinzel (1929) to the genus *Desmorhynchus*, very few concern the region here under consideration. *Desmorhynchus bromelicola* (Beauchamp) 1912 from Costa Rica has the same large eyes and elongated head as *D. angustus* but differs decidedly in color. Of the rhynchodemids described from Colombia by Fuhrmann (1914), two species, *samperi* and *maculatus*, probably should be placed in *Desmorhynchus*, although as noted above this cannot be decided without study of transverse sections. These two species also differ from the present one in color.

TYPE.—Preserved specimen (No. 1385), A.M.N.H. Cat. No. 288.

Numbering of Details on All Figures

- | | |
|--|---|
| 1, mouth | 21, female genital pore |
| 2, ciliated pit | 22, female atrium |
| 3, male copulatory organ | 23, seminal vesicle |
| 4, brain | 24, genito-intestinal canal |
| 5, pharynx | 25, gland cells, a, b, and c, the three types mentioned in text |
| 6, esophagus | 26, copulatory complex |
| 7, intestine | 27, common genital pore |
| 8, egg ball | 28, oviduct |
| 9, testes | 29, cement glands |
| 10, penis pocket | 30, glandular duct |
| 11, protractor muscles of penis | 31, vasa deferentia |
| 12, penis stylet | 32, pigment layer |
| 13, formative cells of stylet | 33, glandulo - muscular adhesive organ |
| 14, two of the four large cells lining penis lumen | 34, longitudinal muscle bundles characteristic of Desmorhynchinae |
| 15, circular muscle layer of penis | 35, ventral nerve cords |
| 16, longitudinal muscle layer (retractors) | 36, seminal bursa |
| 17, sphincter | 37, Beauchamp's canal |
| 18, frontal glands | 38, vaginal pore |
| 19, buccal tube | 39, penis papilla |
| 20, male canal | 40, penis bulb |

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PSEUDODYNERUS, A NEOTROPICAL COMPLEX OF EUMENINE WASPS (HYMENOPTERA, VESPIDAE)

By J. BEQUAERT¹

In 1855, H. de Saussure described briefly and figured a wasp from Colombia, superficially resembling the North American *Pseudodynerus quadrisectus* (Say), and regarded it as a variety of that species. Later he thought he was mistaken and, in 1875, proposed the name "*Monobia maxillaris*" for this Colombian wasp. Zavattari (1912) recognized that this was the species described in 1906 by Brèthes as *Odynerus (Stenodynerus) anisitsii*. A recent attempt to elucidate the status of a number of American wasps homeochromic with *P. quadrisectus*, led me to the present revision of the group.

I have seen material of The American Museum of Natural History, the Museum of Comparative Zoology (Cambridge, Mass.), the United States National Museum, the Philadelphia Academy of Natural Sciences, the Carnegie Museum and some private collectors.

PSEUDODYNERUS DE SAUSSURE

Odynerus subg. *Ancistrocerus* Division *Pseudodynerus* H. DE SAUSSURE, 1855, Et. Fam. Vesp., III, p. 220 (monotypic for *Odynerus luctuosus* de Saussure, 1855).

Dorsal areas of propodeum extending medially to form a horizontal area between the post-scutellum and the concavity; the horizontal area more or less fissurate or grooved medially and separated from the concavity by a crest. Mesonotum without notauli (parapsidal furrows of most authors). Vertical face of pronotum smooth, without pits or depressions. Vertex of female with a large, semi-elliptical, flat or slightly depressed area bearing two dense patches of hairs in pits or grooves. Antenna of male 13-segmented, the last segment folded back as a hook. Labial palpi 4-segmented; maxillary palpi 6-segmented. Second abdominal sternite without a longitudinal basal furrow.

As defined above, *Pseudodynerus* cor-

responds to Zavattari's group of the same name (1912, Arch. f. Naturgesch. LXXVIII, Abt. A, Heft 4, p. 237; as a "Division" of the subgenus *Leionotus* of *Odynerus*). While it may appear more "natural" than most of the other "genera" or "subgenera" that have been split from *Odynerus* in the old sense, it actually consists of two unrelated lines of descent. (a) Species with the horizontal area of the first tergite rectangular and separated from the anterior slope by a blunt, rudimentary carina (particularly marked on the sides): *P. quadrisectus* and *P. maxillaris* (= *anisitsii*). (b) Species with a cup- or dome-shaped first tergite, without even a trace of transverse carina: *P. luctuosus*, *P. migonei*, *P. hallinani*, *P. subapicalis* and *P. serratus*. The first group is clearly transitional to (and perhaps derived from) *Ancistrocerus*, but the second is not.

The relationships of the American *Pseudodynerus* to the *Odynerus*-like wasps with a propodeal dorsal median area of other parts of the world remain to be worked out. It may not be possible to separate them consistently from *Stenodynerus* de Saussure (1863, Mém. Soc. Phys. Hist. Nat. Genève, XVII, pt. 1, p. 228; type by present designation: *Odynerus angustus* de Saussure, 1862). *Pseudodynerus* appears to be even more closely related to the Oriental species which de Saussure (1862, Stettin, Ent. Zeitg., XXIII, p. 184) placed in *Prorhynchium*.² In this con-

² *Prorhynchium* de Saussure (1855, Et. Fam. Vesp., III, p. 174) was originally monotypic for *Rhynchium smithii* de Saussure (1835), a species with a sharp transverse suture on the first tergite (as in *Ancistrocerus*). *Prorhynchium* is therefore not separable from *Pararrhynchium* de Saussure (1855, loc. cit., p. 193; also monotypic for *Ancistrocerus ornatus* F. Smith, 1832). No name appears to be available for the Oriental *Odynerus* with propodeum extending medially beyond the postscutellum, but without or with a rudimentary transverse suture on the first tergite; unless one wishes to include them in *Pseudodynerus*.

¹ Museum of Comparative Zoology, Cambridge, Mass.

nection it is interesting to note that, while de Sausure recognized that the maxillary palpi of *Pseudodynerus luctuosus* approached the *Rygchium* type, he refused to place it in his "genus" *Rygchium* (1875, *Smithson. Miscell. Coll.*, No. 254, p. 143).

KEY TO SPECIES

- 1.—Horizontal area of first tergite separated from the anterior slope by a strong edge bearing a rudimentary, blunt transverse ridge (particularly on the sides)..... 2.
Horizontal area of first tergite either evenly rounded off into the anterior slope or bluntly angular, but never with any trace of transverse ridge 3.
- 2.—Mesonotum densely and fairly uniformly punctate, most of the punctures at least as large as their intervals. Sides of pronotum broad, seen from above forming an obtuse angle with the humeral margin. (First and second tergites with creamy-white preapical margins; postscutellum creamy-white)..... *P. quadrisectus*.
Mesonotum rather sparsely punctate and with a median impunctate area, the punctures much smaller than their intervals. Sides of pronotum narrow, seen from above forming a nearly square angle with the humeral margin. (Tergites with lateral, widely separated, creamy-white spots; postscutellum black) *P. maxillaris*.
- 3.—Most of head and thorax very strongly punctate and coarsely striate, particularly on mesonotum. Concavity of propodeum strongly transversely striate. Second tergite humped or obtusely tuberculate near the middle. *P. luctuosus*.
Head and thorax more weakly punctate and not striate. Concavity of propodeum mostly smooth and shiny, sometimes partly striolate..... 4.
- 4.—Second abdominal tergite longitudinally raised near the middle into a hump or obtuse, low ridge..... 5.
Second abdominal tergite not raised medially into a hump or obtuse ridge 6.
- 5.—Wings violaceous-black in basal two-thirds, milky-white and with pale nervures in apical third. Thorax and abdomen black. Both occipital and humeral margins distinctly curved inward. Clypeus of female distinctly longer than wide. Male: clypeus deeply, triangularly excised at apex; mid-femora deformed, flattened beneath and with a broad oblique depression over basal half..... *P. subapicalis*.
Wings strongly infusate basally and anteriorly, gradually clearer apically, not divided into black basal and milky-white apical areas. Thorax either black or more or less yellowish at the crest and lower ridges of propodeum; sometimes with spots on postscutellum and mid and

hind coxae. Abdomen black or with apical yellow or orange fasciae on some segments. Occipital and humeral margins nearly straight. Clypeus of female about as long as greatest width. Male: clypeus with a very even and shallow inward curve at apex; mid-femora not deformed, merely flattened beneath.....
..... *P. serratus*.

- 6.—First tergite distinctly angular in profile between the posterior horizontal area and the anterior slope, and slightly raised medially. Lateral angles of propodeum broadly rounded off, scarcely marked. Black, with a few ferruginous-orange markings on head, thorax and legs. Wings mostly and fairly uniformly violaceous-black..... *P. hallinani*.
First tergite very evenly rounded off in profile, not raised in the middle. Lateral angles of propodeum prominent, more or less raised into sharp teeth..... 7.
- 7.—Second tergite with a preapical zone of very coarse punctures extending forward in the middle; the remainder much more finely punctate. Crests of superior ridges of propodeum rather low and broadly separated in the middle. Smaller (wing 9 to 11 mm. long); black with very reduced yellowish markings on clypeus, postscutellum, superior and inferior ridges of propodeum, and legs. Wings strongly infusate basally and anteriorly, gradually clearer apically and behind.... *P. griseolus*.
Second tergite fairly uniformly covered with scattered, medium-sized punctures. Crests of superior ridges of propodeum very strong and narrowly separated in the middle. Larger (wing 13 mm. long); black with the propodeum yellow over most of the dorsal areas and along the lateral and inferior ridges; postscutellum partly yellow; a pair of small yellow medio-lateral spots on first tergite. Wings mostly and fairly uniformly violaceous-black..... *P. migonei*.

Pseudodynerus quadrisectus (Say)

A careful comparison of females of North American *quadrisectus* and Mexican *aztecus* fails to disclose differences either in structure or in sculpture. I do not hesitate to regard them as color forms of one species.

- 1.—More extensively marked with creamy-white: humeral margin broad; spots of propodeum large, often covering most of the dorsal areas; preapical bands of first and second tergites broad; lateral spots of first tergite large and more or less extended medially (though never united), so that the horizontal area is often creamy-yellow with a black diamond-shaped spot. (North American).... typical *quadrisectus*.

Creamy-white markings less extensive: humeral margin narrow; propodeum with six small spots or dots; preapical bands of first and second tergites narrow; lateral spots of first tergite small, not produced medially. (Mexican)... var. *aztecus*.

P. quadrisectus, typical form

Odynerus quadrisectus ["Say" HARRIS, 1833, in Hitchcock, Report on Geology, Mineralogy, Botany and Zoology of Massachusetts, 1st Edition, p. 589 (*nomen nudum*)].—SAY, 1837, Boston Jl. Nat. Hist., I, pt. 4, p. 385 (♀ ♂; United States, without more definite locality).

Odynerus (Ancistrocerus) quadrisectus H. DE SAUSSURE, 1855, Et. Fam. Vesp., III, p. 206 (not the variety, nor the figure).

Odynerus (Ancistrocerus, Stenancistrocerus) quadrisectus H. DE SAUSSURE, 1875, Smithsonian Miscell. Coll., No. 254, p. 193 (♀ ♂).

Ancistrocerus (Pseudodynerus) quadrisectus J. BEQUAERT, 1925, Trans. Amer. Ent. Soc., LI, pp. 69 and 77 (♀ ♂).

Odynerus bellone LEPELETIER DE ST. FARGEAU, 1841, Hist. Nat. Ins. Hym., II, p. 660 (♀ ♂; Carolina, North America).

Odynerus (Ancistrocerus) bellone H. DE SAUSSURE, 1853, Et. Fam. Vesp., I, p. 146 (♀ ♂).

No complete bibliography of this North American wasp is here given. It occurs over most of the eastern United States (east of the 100th Meridian), as far north as northern New Jersey. I have seen it from the following States: New Jersey (Englewood, opposite New York City, northernmost locality known), Pennsylvania (Pittsburgh; Ingram; West View; Aspinwall; Westmoreland Co.; Allegheny Co.; Washington Co.; Rockview; Huntingdon), Delaware (New Castle Co.), Maryland, District of Columbia, West Virginia (French Oak), Virginia (Dismal Swamp), North Carolina (Cape Henry; Ashford; Southern Pines; Valley of Black Mts.; Dillesboro), South Carolina (Horry Co.; Greenville), Georgia (Tifton; Savannah), Florida (Indian River; Driflon, Jefferson Co.; Paradise Key, Dade Co.; Miami; Fort Lauderdale; Anclote River, Elfers; Coconut Grove; Monticello; Pine Crest, Collier Co.; Crescent City; Gainesville; Royal Palm Park; Clearwater; Fort Myers; Enterprise; Deep Lake; Lake Worth; Flamingo; Biscayne Bay), Louisiana, eastern Texas (Brazos Co.; Bastrop Co.; Feder; McDade; Dickinson), Oklahoma (Osage Co.; Grove), eastern Kansas (Baldwin), Missouri, Arkansas (Cottes),

Kentucky, Tennessee (Roan Mt. Sta., Carter Co.), Illinois (Hilliary, 6 miles west of Danville, Vermilion Co.; Alto Pass, Union Co.; Aldridge, Union Co.; Fountain Bluff, Jackson Co.; Du Bois, Washington Co.; Havana, Mason Co.; Homer Park, Champaign Co.; Oakwood, Vermilion Co.) and Ohio (Ashland Co.; Sandusky Co.; Jug Run; Smithfield, Jefferson Co.; Columbus; Big Darby, Franklin Co.; Buckeye Lake; Marietta, Highland Co.; Lawrence Co.). There is as yet no record from New York State or from New England.¹

P. quadrisectus is clearly a Neotropical element in the Nearctic fauna, together with *Monobia quadridens* (Linnaeus), *Rygchium bidens* (de Saussure), *Pachymenes symmorphus* de Saussure, and the species of *Pachodynerus* and *Mischocyttarus*.

An unusual feature of this species is the color of the clypeus. In the female, this is black with two curved creamy-white lateral spots in the upper half, close to the inner orbits. In the male, it is black with or without the lateral spots of the female (usually much reduced when present) and with or without a median pair of elongate creamy-white spots on the preapical carinae; exceptionally the clypeus is more extensively yellow, leaving only a black spearhead-shaped median area. Moreover, the extent of the creamy-white markings varies considerably, even in the same locality. Tegulae and scutellum are generally black, exceptionally with spots (in one female, the spots of the scutellum form a medially interrupted band). In two males there is a small lateral dot on each side near the base of the second tergite and one of these bears small lateral streaks on the third tergite. The most northern female I have seen (from Englewood, New Jersey) is richly marked, having spotted tegulae and scutellum.

This wasp varies much in size. The fore wing measures from 12 to 16 mm. in length in the female, and from 10.5 to 13 mm. in the male.

Thaddeus William Harris, in 1833, first

¹ With the exception of Englewood, the localities here listed are additional to those given in my 1923 paper.

published the name "*Odynerus quadrisectus* Say," without description, but with the locality "North Carolina" ("N. C."). In the Harris Collection, now at the New England Museum of Natural History (Boston), there is a female of *quadrisectus* named by Say himself and no doubt the specimen recorded by Harris in 1833. As this was four years before Say published his description, the specimen is obviously one of the original types and, so far as known, the only one now in existence. I have examined this wasp and it is of the species now called *quadrisectus*. The type of Lepeletier's *bellone* is probably at the Paris Museum.

P. quadrisectus var. aztecus (de Saussure)

Odynerus (Odynerus) aztecus H. DE SAUSSURE, 1857, Rev. Mag. Zool., (2) IX, p. 275 (♀ ♂; Tampico, Mexico).

Odynerus (Ancistrocerus, Stenancistrocerus) aztecus H. DE SAUSSURE, 1875, Smithsonian. Miscell. Coll., No. 254, p. 192 (♀ ♂).

Odynerus aztecus DALLA TORRE, 1894, Cat. Hym., IX, p. 55.

Odynerus (Ancistrocerus) aztecus DALLA TORRE, 1904, Gen. Insect., Vesp., p. 40.

SPECIMENS EXAMINED.—Mexico: Chichen Itza, Yucatan, 3 females, June, 1929 (J. Bequaert); San Rafael, Jicoltepec, State of Vera Cruz, 3 males.

These six specimens agree almost to the letter with de Saussure's detailed description (1875), except that the mid and hind coxae are streaked with creamy-white. The submarginal border of the second tergite is continuous in all. The size of the spots on the propodeum varies. In the female, the clypeus is black with broad upper lateral yellow margins and two preapical yellow streaks; in the male, it is entirely yellow. The size varies: fore wing 13 to 15 mm. long in female, 10.5 to 12 mm. in male.

It is remarkable that the more tropical form of this species should show a reduction in the extent of the pale markings.

H. de Saussure's types are probably in Geneva.

Pseudodynerus maxillaris (de Saussure)

Zavattari recognized that *O. anisitsii* Brèthes was the wasp from Colombia which

de Saussure originally regarded as a variety of *O. quadrisectus*, but later named *Monobia maxillaris*. He preferred, however, to use Brèthes' later name. I cannot agree with his statement that *M. maxillaris* was never described. In fact it was based on a published figure, which itself was accompanied by a description.

The only reliable structural differences I can find between *P. quadrisectus* and *P. maxillaris* are those given in the key. Bertoni (1918) states that in *P. quadrisectus* the lateral angles of the propodeum are not sharply projecting, as in *P. maxillaris*. But the shape of the lateral angles varies considerably in my large series of *quadrisectus*, being either completely rounded off or more or less produced; and in some cases they are exactly as in *maxillaris*.

Two color forms may be recognized.

- 1.—Tergites 1 and 2 only with lateral spots (exceptionally the third also with a small spot).....typical *maxillaris*.
Tergites 1, 2, 3, and 4 with large lateral spots
.....var. *garleppi*.

P. maxillaris, typical form

Odynerus (Ancistrocerus) quadrisectus var. H. DE SAUSSURE, 1855, Et. Fam. Vesp., III, p. 206, Pl. ix, fig. 9 (♀; Santa Marta, Colombia).

Monobia maxillaris H. DE SAUSSURE, 1875, Smithsonian. Miscell. Coll., No. 254, p. 193, footnote (♀; with reference to his Pl. ix, fig. 9 of 1855).

Odynerus (Stenodynerus) anisitsii BRÈTHES, 1906, An. Mus. Nac. Buenos Aires, (3) VI, p. 386 (♀; Villa Morra, Paraguay).—A. DE WINKLER, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 200 and 207.

Odynerus (Leionotus, Pseudodynerus) anisitsii ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, pp. 238 and 239.

SPECIMENS EXAMINED.—Costa Rica: Without more definite locality, one female (Schild and Burgdorf).—Colombia: Cagualito, 20 miles E. of Santa Marta, 1500 ft., two females (Herbert H. Smith); Muzo, Dept. Boyacá, 900 m., one female (J. Bequaert).—Bolivia: Las Juntas, two males (Steinbach); Cuatro Ojos, one male (Steinbach); Sa. Cruz de la Sierra, one female (Steinbach); Prov. Sara, one female (Steinbach); Buenavista, Dept. Sa. Cruz, 450 m., one female.—Paraguay: Sapucay, one female (W. T. Foster); Villarrica, two females (F. Schade).

The typical form is also reported from southern Brazil (São Paulo; Espírito Santo). In Colombia it occurs only in the Tierra Caliente, Zavattari's record from "Bogotá" being based on an error in labeling.¹

Of the seven females seen, six are marked exactly as figured by de Saussure and described by Brèthes. The female from Buenavista, Bolivia, however, has in addition to the spots on tergites 1 and 2, a transverse preapical spot on each side of tergite 3, being therefore transitional to var. *garleppi*.

H. de Saussure's type of *maxillaris* is probably in Geneva. Brèthes type of *anisitsii* was described from the collection of the "Escuela Normal de Señoritas No. 1" of Buenos Aires.

P. maxillaris var. *garleppi* Schrottky

Stenodynerus anisitsii subsp. *garleppi* SCHROTTKY, 1911, Ent. Rundschau, XXVIII, p. 11 (♀; Cuzco, Peru).

This differs from typical *maxillaris* only "durch gelbe Seitenflecken auf den Tergiten 3 und 4." I have taken at Restrepo, Int. Meta, 500 m., Colombia, a female of this variety, which is scarcely worth recognizing by name.

Pseudodynerus luctuosus (de Saussure)

I have reached the conclusion that *O. mina-palumboi* Gribodo and *O. beelzebub* Zavattari are merely color variations of *P. luctuosus*. So few specimens are known that one cannot decide whether or not these forms should be recognized by name.

¹ In his 1912 paper Zavattari lists from "Bogotá" forty solitary Vespidae belonging to *Zethus*, *Pachymenes*, *Eumenes*, *Montezumia*, *Ancistrocerus*, *Pseudodynerus*, *Pachodynerus*, *Odynerus*, and *Alastor*. Twenty of these are described as new, "Bogotá" being given as the type locality. These "Bogotá" wasps were all of the Berlin Museum, Lindig being given as the collector. In 1936 I collected several days at Bogotá and environs, particularly in order to obtain Zavattari's species. I was surprised to find, however, that the Vespidae fauna was extremely poor. No social species were seen and only two solitary species taken: *Pachymenes ventricosus* de Saussure and *Odynerus romandinus* de Saussure. I was also able to go over the collections of Hymenoptera made over a number of years by Hermano Apolinar-Maria, at the Instituto LaSalle. These contained from Bogotá only *Pseudodynerus luctuosus* in addition to the two species mentioned above. While a few more species may eventually be found in the vicinity of Bogotá, I feel quite certain that most of Zavattari's records were based on specimens "shipped" from Bogotá, but collected elsewhere and mostly in the warmer parts of Colombia.

From the published descriptions they may be separated as follows:

- 1.—Thorax and abdomen entirely black. Wings slightly subhyaline in the fourth submarginal cell.....var. *beelzebub*. Thorax and abdomen not both entirely black. Wings entirely violaceous-black.....2.
- 2.—Thorax with creamy-white or pale yellow spots on pronotum and dorsal areas of propodeum. Abdomen with two rounded pale yellow spots at the base of the second tergite.....var. *mina-palumboi*. Thorax black, without spots. Abdomen with two rounded creamy-yellow spots near the base of second tergite.....typical *luctuosus*.

P. luctuosus, typical form

Odynerus (Ancistrocerus, Pseudodynerus) luctuosus H. DE SAUSSURE, 1855, Et. Fam. Vesp., III, p. 220 (♀; "L'Amérique. Probablement la Caroline du Sud").

Odynerus luctuosus F. SMITH, 1857, Cat. Hym. Brit. Mus., V, p. 83.—DALLA TORRE, 1894, Cat. Hym., IX, p. 76.

Odynerus (Odynerus, Stenodynerus) luctuosus H. DE SAUSSURE, 1875, Smithsonian. Miscell. Coll., No. 254, p. 311 (♀).

Odynerus (Lionotus) luctuosus DALLA TORRE, 1904, Gen. Insect., Vesp., p. 48.

Odynerus (Lionotus, Pseudodynerus) luctuosus ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, p. 238 (♀).

As Zavattari recognized, this is a South American wasp, known with certainty thus far from Colombia only. Zavattari records it from Bogotá and Hermano Apolinar-Maria has sent a female taken in that locality. It was observed in the "savanna" or highland plain by Mr. Luis Maria Murillo, who found it nesting in the hollow stalks of reeds. (Altitude approximately 2,600 m.)

H. de Saussure's type should be in Geneva. There is no evidence whatever that this wasp occurs in the United States.

P. luctuosus var. *mina-palumboi* (Gribodo)

Monobia mina-palumboi GRIBODO, 1891, Boll. Soc. Ent. Italiana, XXIII, p. 270 (♀; Muzo, Colombia).—DALLA TORRE, 1894, Cat. Hym., IX, p. 41; 1904, Gen. Insect., Vesp., p. 29.—DUCKE, 1911, Revue d'Entom., XXVIII, p. 180.

Odynerus (Lionotus, Pseudodynerus) mina-palumboi ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, p. 238 (♀).

This variety is known only from Colom-

bia. Zavattari, who saw the type at Turin, recognized that it was not a *Monobia*, but a close relative of *O. luctuosus*. He also records it from Bogotá.

***P. luctuosus* var. *beelzebub* (Zavattari)**

Odynerus (*Leionotus*, *Pseudodynerus*) *beelzebub* ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, pp. 237 and 239 (♀; Appula, Venezuela).

This variety is known only from the type at the Berlin Museum.

***Pseudodynerus subapicalis* (Fox)**

Odynerus (*Stenodynerus*) *subapicalis* FOX, 1902, Proc. Ac. Nat. Sci. Philadelphia, pp. 67 and 69 (♀ ♂: Mararu; Chapada; Rio de Janeiro; Santarem; all in Brazil).

Odynerus (*Leionotus*) *subapicalis* DALLA TORRE, 1904, Gen. Insect., Vesp., p. 55.

Stenodynerus subapicalis A. DE WINKELRIED BERTONI, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 202 and 207.

SPECIMENS EXAMINED.—Peru: El Campamento, Col. Perene, June 19, 1920, one female (J. C. Bradley).—Colombia: Restrepo, Int. Meta, 500 m., one female and two males, at flowers of *Mikania scandens* (J. Bequaert); Cacagualito, 20 miles east of Santa Marta, 1,500 ft., Dept. Magdalena, one female (Herbert H. Smith).

I have also seen Fox' types at the Carnegie Museum in Pittsburgh. The species is now known from Brazil, Paraguay, Peru, and Colombia.

The female type has two brushes of hairs on the vertex behind the ocelli, as in other species of *Pseudodynerus*. Although this species agrees with *P. serratus* in the humped second tergite, it is readily separated structurally by the characters given in the key.

***Pseudodynerus serratus* (Fox)**

O. serratus Fox, *O. griseus* Fox, *O. penicillatus* Zavattari, *O. crinitus* Zavattari, and *S. mondaiensis* Bertoni are probably all color variants of one structural species, but my material is insufficient either to settle the matter or to decide how many of the forms deserve recognition in nomenclature. All specimens I have seen are either typical *serratus* (with well-marked, broad, bright yellow apical fasciae on tergites 2 to 5) or the var. *griseus* (with the

abdomen black or very slightly testaceous along the apical margins of tergites 2 to 5). It should be noted that the female type of *griseus* bears two brushes of black hairs on the vertex (not mentioned by Fox); while the male type of *serratus* has the first abdominal tergite *not* transversely carinate or furrowed (the "not" was accidentally omitted from the text of the original description; but in the "key," on pp. 67–69, the species is placed correctly in the group with "first abdominal segment *not* carinated").

So far as may be judged from the descriptions, *O. crinitus* is not separable from *P. serratus* var. *griseus*; *O. mondaiensis* appears to be identical with typical *P. serratus*; but *O. penicillatus* may be a distinct color form.

Fox states of the male type of *O. serratus*: "The first segment bears above close to apical margin a tooth-like projection, which may be a malformation. Other specimens are needed to verify this." While in the type this structure appears perfectly normal, it nevertheless must be an abnormality, since none of the other specimens of *O. serratus* seen, of either sex, show a trace of it, although they agree in every other respect with Fox' type.

***P. serratus*, typical form**

Odynerus (*Stenodynerus*) *serratus* FOX, 1902, Proc. Ac. Nat. Sci. Philadelphia, pp. 65 and 69 (♂; Corumbá, Brazil).

Odynerus (*Ancistrocerus*) *serratus* DALLA TORRE, 1904, Gen. Insect., Vesp., p. 54.

Stenodynerus serratus A. DE WINKELRIED BERTONI, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 192, 202, and 207 (on p. 208, also as *Odynerus* (*Stenancistrocerus*) *serratus*).

SPECIMENS EXAMINED.—Paraguay: Villarrica, one female (allotype) and one male (F. Schade). Allotype at Mus. Comp. Zool., Cambridge, Mass.

I have compared these specimens with the type at the Carnegie Museum.

Most probably *mondaiensis* Bertoni is identical with the typical form of *P. serratus* (see below).

FEMALE (undescribed).—Very similar to the male in structure and color markings. Clypeus entirely black, broadly pear-shaped, about as high as wide; apical margin slightly less than one-third of greatest width, with a distinct,

though slight inward curve, and short, sharp lateral angles. Vertex with the usual two brushes of erect hairs.

Length (h. + th. + t. 1 + 2): 10.5 mm.; of fore wing, 10 mm.

P. serratus var. mondaicensis (Bertoni)

Stenodynerus mondaicensis A. DE WINKELRIED BERTONI, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 200 and 207 (♀ ♂; Puerto Bertoni, Paraguay).

I have not seen this form, the description of which is reproduced below. I am unable to see how it is to be separated from typical *P. serratus*. The type of *P. serratus* agrees well with Bertoni's account, the author himself pointing out that the color is rather variable.

"*Faem. S. serrato* Foxi similis; sed griseo-puberulus, alis fusco-hyalinis, segmento mediario flavo ornato abdominisque segmentorum 2-5 apicibus crasse punctatis. Niger; mandibularum basi, oculorum margine contra antennas, clypei margine utrinque lineolisque duabus apicalibus, scapo subtus, punctis duobus inter antennas, femoris 1^a linea antica, metanoti crista et punctulo utrinque abdominisque segmentorum 2-6 apice (late), flavis; abdominis segmento 1^o utrinque ferrugineo-limbato; tegulis testaceo-unimaculatis; flagello subtus, tarsisque apice, ferrugineis. Abdominis segmento primo haud transverse carinato. Clypeo crasse rugoso-punctato, subtiliter granuloso, apice trianguliter emarginato, bidentato, sat bicarinato; metanoti foveola postica sparsissime punctata, inferne transversaliter striata. Long. corp. 13 mm.; al. 10.—*Var. a*: carina inter antennas basi flava; *b*: clypeo, scapo et carina inter antennas, nigris; *c*: clypeo apice nigro; mandibulis plus minusve nigris, abdominis segmentis 2-6 anguste ochraceo-limbatis, sternitis limbis fere nullis.—El color de las alas también es un tanto variable. El macho no ofrece diferencias notables; el clypeo con igual diseño y escodatura, parece más corto que en la hembra."

P. serratus var. griseus (Fox)

Odynerus (Stenodynerus) griseus Fox, 1902, Proc. Ac. Nat. Sci. Philadelphia, pp. 66 and 69 (♀ ♂; Chapada and Corumbá, Brazil).

Odynerus (Symmorphus) griseus DALLA TORRE, 1904, Gen. Insect., Vesp., p. 46.

Stenodynerus griseus A. DE WINKELRIED BERTONI, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 202 and 207.

Odynerus (Leionotus, Pseudodynerus) crinitus ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, pp. 238 and 241 (♀; São João del Rei, Brazil).

I have seen the types and paratypes of *O. griseus* and I am unable to find a reliable structural character to separate

them from typical *serratus*. These types are colored like Zavattari's female *crinitus*, which no doubt is the same form. In particular they have the scape black or somewhat ferruginous beneath and the mid and hind coxae spotted with yellow.

P. serratus var. penicillatus (Zavattari)

Odynerus (Leionotus, Pseudodynerus) penicillatus ZAVATTARI, 1912, Arch. f. Naturg., LXXVIII, Abt. A, Heft 4, pp. 238 and 240 (♀; Cayenne, French Guiana).

I have not seen this form, but from the description it would seem to be a color form of *P. serratus*. Zavattari separates it from his *crinitus* (= *serratus* var. *griseus*) by the different punctation (coarser and denser on the thorax in *penicillatus*), the color of the scape (with a yellow line beneath), of the mid and hind coxae (without yellow spots) and of the wings ("alis hyalinis paulum flavescentibus ad costam aliquantulo infumatis, nervis et stigmatibus piceis").

Pseudodynerus auratoides (Bertoni)

Stenodynerus auratoides A. DE WINKELRIED BERTONI, 1918, An. Cient. Paraguayos, (2) No. 3, pp. 201 and 207 (♀ ♂; Puerto Bertoni, Paraguay).

I have not seen this species, the description of which is reproduced below. It is evidently very closely related to *P. serratus* and *P. subapicalis* owing to the humped second tergite. In some respects it agrees better with my specimens of *P. subapicalis* than with *P. serratus*, although the color is practically that of typical *serratus*. The shape of the mid-femora of the male is not mentioned.¹

"*O. (St.) serrato* similis; sed major, clypeo magis flavo, metanoto pone post-scutellum minus producto abdominisque segmento primo haud transverse impresso.—*Faem.* Atra, dense aureo-sericea; mandibulis longitudinaliter, marginibus lateralibus clypei, frontis punctis 2 vix contiguus et fascia transversa prope clypeum, scapo subtus, margine oculorum contra antennas, tibiis anticis intus, spina mesonoti, metanoti canthis, abdominis segmentorum 2^a—5^a apice 6^o—que segmento in medio, flavis; labro ex flavo-ferrugineo; pedibus anticis fere obscure-ferrugineis, aureo-hirtis. Alis ferrugineis, apice

¹ A female of *P. auratoides*, from Nova Teutonia, Est. Sa Catharina, Brazil, recently received from Mr. F. Plaumann, shows that this is a distinct species, readily separated from *P. serratus* by the shape of the postscutellum.

fuscum hyalinum. Capite dense irregulariterque punctato, sparsim tomentoso, vertice cirris 2 pilorum fuscorum instructo; carina interantennalia sursum versus lineato-impresca; clypeo subcordiformi, striato-punctato et minute granuloso, apice biangulato, paulum triangulariter emarginato; mandibulis 3-striatis. Thorace elongato sat punctato punctulatoque; pronoto antice cristato, angulato, utrinque cum pleuris rotundato-congruente; mesonoto dense tomentoso, paulum convexo, lineis nullis, prope tegulas vix impunctato; tegulis sericeis, fere impunctatis; scutello transverso, longitudinaliter paulo carinato, sparsim punctato et punctulato; postscutello integro, confertim et grosse punctato, postice depresso; metanoto in medio supra quam post-scutellum sat brevius, grosse crebreque punctato, cristato-serrato ut in *O. serrato* Foxi; foveola postica sat concava, puberula, punctis fere nullis, verticaliter excisa, utrinque acute unidentata, inferne transverse bistriata; mesopleuris crebre punctatis, metapleuris oblique strigatis. Abdomine densissime sericeo, ovato-oblongo, modice punctato; segmento 1° antice truncato, magis lato quam longo, supra cupuliformi, in medio paulo impresso, subtus carina transversa laevigata; segmento 2° magis lato quam longo, cupuliformi, supra in tuberculum tumescentem productum; 5°-6° fere laevigatis. Long. corp. 14-17 mm., al. 11-12.—*Mas.* Clypeo magis flavo, elongato, valde emarginato, sparse punctato; labro flavo; mandibulis longitudinaliter sulphureis; tegulis nigris; abdominis tuberculo fere nullo; unco antennarum gracili, ferrugineo, subcylindrico, usque ad apicem art. 10^m attingente. Long. 12-13 mm."

Pseudodynerus griseolus (Brèthes)

Odynerus (*Stenodynerus*) *griseolus* Brèthes, 1909, An. Mus. Nac. Buenos Aires, (3) XII, p. 58 (♂; Tucuman, Argentina).

SPECIMENS EXAMINED.—Brazil: Corumbá, State of Matto Grosso, one female (allotype) and one male, December, 1919 (J. C. Bradley). Allotype at Mus. Comp. Zool., Cambridge, Mass.

The male of this pair agrees perfectly with Brèthes' description. The species resembles certain forms of *P. serratus*, the main difference being the lack of even a trace of hump on the second tergite; in addition, the median portion of the propodeum is shorter and more openly grooved than in *serratus*, with the crests of the upper ridges much shorter and farther apart, and both occipital and humeral margins are deeply curved inward.

FEMALE (undescribed).—Similar in structure and color markings to the male. Clypeus very broadly pear-shaped, about as wide as long; apical margin about one-third of greatest width,

with a deep, semi-elliptical emargination, the lateral angles forming long and sharp, flat, triangular teeth. Clypeus black, with upper lateral margins and two small spots in lower third yellow.

Length (h. + th. + t. 1 + 2): 11.5 mm.; of fore wing, 11.5 mm.

Pseudodynerus migonei (Bertoni)

Odynerus (*Stenodynerus*) *migonei* A. DE WINKELRIED BERTONI, 1926, Rev. Soc. Cient. Paraguay, II, 1 (1925) p. 77 (♀; Cordillera Amambai, 56° W., 23° 30' S., Paraguay).

SPECIMEN EXAMINED.—Brazil: Maracajú, Est. Matto Grosso, April-May, 1937, one female (G. Fairchild).

This female agrees in every detail with Bertoni's description, which is here reproduced: "*Faem.* Atr. postscutelli linea transversa, metanoto maxima parte (foveola nigra) abdominalis segmento 1° puncto utrinque, luteis. Alis nigrocyanis. Clypeo cordiformi, valde punctato, semicirculariter emarginato. Capite thoraceque dense punctatis; vertice cirris 2 pilorum instructo, semicirculariter impresso; metanoto pone postscutellum productum, serrato-cristato; foveola rotundata margine utrinque unidentata. Abdomine modice punctato, griseo sericeo; 1° segmento antice rotundato, magis lato quam longo, in medio supra longitudinaliter impresso. Long. corp. 15 mm., al. 13."

Pseudodynerus hallinani, new species

Medium-sized; black with a few ferruginous-orange markings on head, thorax and legs; wings violaceous-black. First tergite angular in profile and slightly raised medially; second tergite not humped, uniformly punctate. Propodeum with lateral angles broadly rounded off; superior ridges crested over upper horizontal portion only. Length (h. + th. + t. 1 + 2): 12.5 mm.; of fore wing, 12 mm.

FEMALE.—Head (Fig. 1B) subcircular seen in front, nearly as high as wide; seen from above, transverse, about one and a half times as wide as long; occipital margin nearly straight. Vertex and cheeks margined throughout by a sharp carina, which is stronger on the cheeks than at the occiput. Cheeks very wide and distinctly swollen in the upper two-thirds, as wide at the occiput as the upper part of the eye in profile, gradually narrowed to the lower third and thence more rapidly to the base of the mandible; marginal carina evenly curved, convex, separated only by a narrow groove from the eye near the mandible. Inner orbits farther apart on the vertex than at the clypeus; upper half of frons scarcely swollen. Ocelli in a flattened triangle; posterior pair about as far apart as from the eyes and more than twice as far from the occipital margin. Intercellar area and vertex slightly flattened; the two tufts of brownish hairs of the vertex unusually large, long and dense, narrowly

divided medially. Antennal sockets about twice as far apart as from the eyes; area between them slightly raised and with a low, blunt, median, even keel. Clypeus elongate pear-shaped, slightly longer than wide, scarcely convex; disk flattened medially in upper half, depressed or somewhat excavated in lower part; apical, free portion longer than basal, interocular part; apical margin about one-third of the greatest width of the clypeus, with a very slight inward curve; the lateral angles broadly triangular, rounded off, each bearing a blunt carina which extends over the lower third of the clypeus (the two carinae slightly diverging above). Antenna: scape slender; flagellum almost uni-

carina, narrowly interrupted in the middle; the carina much stronger on the sides, below the humeral angles, which are square, not prominent, blunt; sides of pronotum slightly shouldered, but not ridged between the dorsal and lateral areas. Mesonotum longer than wide; notauli absent. Tegula short and broad, normal; posttegula distinct, broad. Scutellum rectangular, nearly twice as wide as long, flat, not depressed medially. Postscutellum very broadly triangular, about half as long as scutellum, from which it is separated by a deep, smooth suture; nearly horizontal, slightly swollen transversely over anterior half. Mesepisternal suture complete; a strong prepectal suture from the mese-

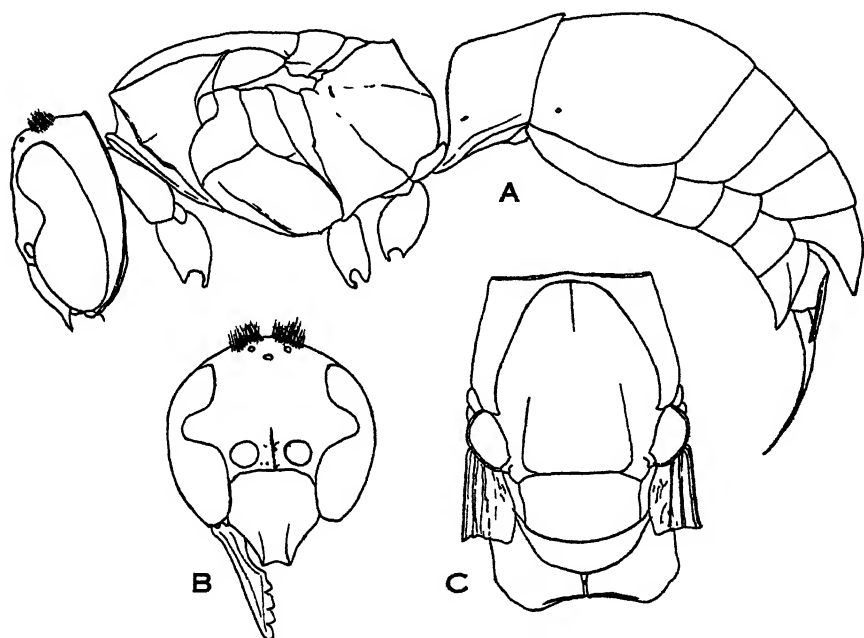


Fig. 1. *Pseudodynerus hallinani* J. Bequaert, female holotype: A, body in profile; B, head seen in front; C, thorax from above.

formly thick throughout. Mandible slightly shorter than the height of the eye, straight, rather narrow; apex bluntly pointed, slightly curved; inner cutting edge with three long, low teeth. Maxillary palpi of six segments, which decrease gradually in length from the first to the fifth, the sixth distinctly longer than the fifth. Labial palpi of four segments, the last about half the length of the third.

Thorax (Fig. 1A and C) rectangular from above, slightly narrower anteriorly than posteriorly, about one and one-third times as long as wide across the tegulae. Pronotum distinctly but gradually narrowed toward the humeral margin, which is straight and bears a low, fine

pisternal suture to the middle of the mesosternum. Propodeum long, vertically truncate behind, moderately swollen on the sides; dorsal areas touching each other broadly; the median horizontal area only slightly shorter than the postscutellum, divided by a narrow furrow; concavity very wide, moderately depressed; superior ridges with a sharp, slightly curved crest in upper horizontal portion only, the edge of the crest translucent and somewhat jagged; the two crests broadly separated by the median notch; lateral ridges very weak, blunt; inferior ridges rounded off; lateral angles not at all marked, very broadly rounded off; no teeth near articular valvulae.

Abdomen (Fig. 1A) moderately stubby and rather evenly narrowed anteriorly and posteriorly, slightly depressed. First tergite short, transverse, nearly rectangular seen from above; its horizontal portion about one and a half times as wide as long in the middle, slightly narrower than the second; in profile about half the length of the second tergite, very abruptly sloping anteriorly; the transition between the slope and the horizontal area bluntly angular, slightly raised or almost tuberculate medially; dorsally with a shallow longitudinal depression. Apical margins of all tergites normal, not thickened nor raised, very narrowly translucent. Second tergite evenly convex, not humped; second sternite very evenly convex basally; the postarticular transverse groove smooth, not ribbed nor foveolate. Legs normal. Venation as usual.

Head and thorax mostly covered with coarse punctures, somewhat finer on scutellum, very weak on sides and apex of clypeus and on post-scutellum; the space between the larger punctures of the thorax with minute punctures; concavity of propodeum and tegulae impunctate, smooth. Abdomen with medium-sized, distant, evenly scattered punctures; those of the basal

half of the second tergite much finer, but gradually merging into the coarser apical punctation. Erect pilosity sparse, gray.

Black, with the following ferruginous or orange-ferruginous markings: most of mandibles; scape; under side of flagellum (extending over most of the basal segments); a streak on upper cheeks; anterior half, hind margin and lateral lobes of pronotum; tegulae; posttegulae; a small spot on upper mesopleura; two transverse spots on postscutellum; crests of superior ridges and lateral angles of propodeum; articular valvulae; very narrow apical margins of first tergite; and most of legs (coxae, mid and hind femora, and outer side of mid and hind tibiae black or brownish-black). Upper and lateral margins and apical carinae of clypeus, narrow lower inner orbits, supra-antennal frontal spot, and middle of mandibles, yellow, edged with ferruginous. Wings uniformly purplish black.

Canal Zone of Panama: Culebra-Arrijan Trail, female holotype, November 26, 1914 (T. Hallinan). American Museum of Natural History.

AMERICAN MUSEUM NOVITATES

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FOUR NEW FISHES FROM WESTERN CHINA

By J. T. NICHOLS

Through the kind offices of Mr. Dean Sage and The American Museum of Natural History's Department of Mammalogy, a collection of upward of 50 species of fishes from western China has been placed in my hands for study. Coming from a different faunal area than collections made earlier by the Asiatic Expeditions of the Museum, it contains a number of species I had listed but not previously seen, some recently and some long described, and is hence of no little interest. Two catfishes and two carps in this collection apparently represent undescribed forms. Drawings of two of the types are by J. J. Ter Pelkwijk.

Leiocassis omeihensis, new species

DESCRIPTION OF TYPE.—No. 15217 American Museum of Natural History, from Omeihsein, Szechwan, China, altitude 1600 ft., collected August, 1938, by C. K. Liu.

Length to base of caudal, 103 mm. Depth in this length, 3.6; head, 4.3. Eye in head, 7; snout, 2.7; interorbital, 2.8; maxillary, 3; width of mouth, 2.4; maxillary barbel, 4; greatest width of body, 1.3; depth of peduncle, 2.2; its length, 1.8; dorsal spine, 2.1; pectoral spine, 2.1; longest dorsal ray, 2.5; longest anal ray, 2.4; caudal, 1.4; pectoral, 1.9; ventral, 2.1; adipose base, 1.5; dorsal interspace, 1.2.

Dorsal rays, I, 7; anal, 15.

Bones of head well covered; snout blunt, somewhat projecting; mouth inferior, transverse, with thick, slightly striate lips; eye small, with a free rim; barbels all small. Dorsal and pectoral spines small, the dorsal spine slender, smooth on both edges; pectoral spine heavier, serrate on the inner edge; adipose low in front, becoming gradually higher posteriorly, distance from its axil to its free posterior angle, 4.5 in its base; caudal rounded, with precurent rays forming keels above and below, a slight notch in the center of its hind margin.

Color in preservative gray, darker on top of head, pale from jaws to ventrals; adipose and caudal dusky; ventrals pale; dorsal pale with a broad dusky margin; anal pale in center, somewhat dusky at base and margin.

Only one specimen, which resembles

Leiocassis medianalis from Yunnan somewhat, but has a deeper body, smaller spines, shorter anal, and other differences from this.

Glyptosternon punctatum, new species

DESCRIPTION OF TYPE.—No. 15218 American Museum of Natural History, from Kiating, Szechwan, China, altitude 1100 ft., collected July, 1938, by C. K. Liu.

Length to base of caudal, 72 mm. Depth in this length, 5.3; head, 4. Width of head in head, 1.3; interorbital, 3.5; width of mouth, 2; maxillary barbel, 1.2; depth of peduncle, 2.7; its length (from anal axil), 1.5; dorsal spine, 2; pectoral spine, 1.5; longest dorsal ray, 1.8; height of adipose, 4; its base, 2; dorsal interspace, 1; caudal lobe, 1.1; longest anal ray, 1.7; pectoral, 1.2; ventral, 1.6. Eye in interorbital, 2.5.

Dorsal rays, I, 6; anal, 10. Skin in large part densely papillose.

Body flattened below, back to the ventrals, striate between the pectorals which are almost horizontal; the head depressed, especially in front, gently convex above, well covered with skin. The broad flattened maxillary barbel reaches about to base of pectoral; gill-membranes are joined to a moderately broad isthmus. Pectoral spine stout, strongly barbed on the inside; dorsal spine weakly serrate behind; pectoral reaching $4/5$ the distance to ventrals, ventrals $4/5$ to anal; caudal moderately forked, with rounded lobes about equal in length.

Color in preservative dark gray, pale on lower surface of head and breast; with scattered blackish spots on back and caudal, which coalesce to form a dark band from the adipose to the anal axil; dark basal and submarginal bands on dorsal and anal; adipose dark, its free portion pale.

Compared with specimens of *G. fokiensis* and *G. sinense*, it resembles the latter, but differs from it notably in having a deeper peduncle, and caudal with equal rounded lobes.

A second specimen 68 mm. long, collected in August but otherwise with the same data, is deeper (depth, 4.5), with longer barbels (maxillary barbel as long as head, reaching past pectoral base), and much less notice-

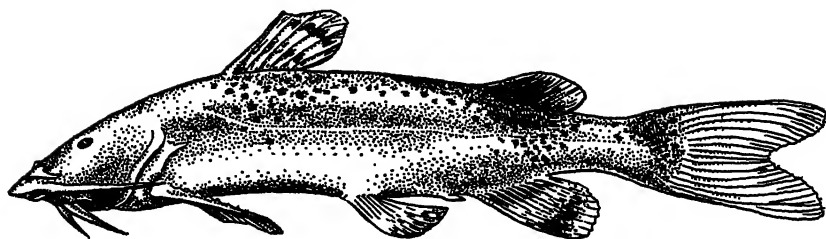


Fig. 1. *Glyptosternon punctatum*, type. Standard length 72 mm.

ably spotted. The proportions of its peduncle are similar to those of the type's.

Rasborinus taeniatus, new species

DESCRIPTION OF TYPE.—No. 15219 American Museum of Natural History, from Kiating, Szechwan, China, altitude 1100 ft., collected July, 1938, by C. K. Liu.

Length to base of caudal, 85 mm. Depth in this length, 3.9; head, 3.7. Eye in head, 3.5; snout, 3.7; maxillary, 3.5; interorbital, 3.2; width of body, 2; depth of peduncle, 2.3; its length, 1.4; longest dorsal ray, 1.1; longest anal ray, 2; caudal broken; pectoral, 1.2; ventral, 1.5.

Dorsal rays, 9 (the second spinous at base, soft and segmented at tip); anal rays, 17. Scales, about 51.

Body compressed, breast before ventrals well rounded, belly behind ventrals keeled. Interorbital slightly convex; mouth oblique, maxillary not reaching to under front of eye; lower jaw very slightly included. Dorsal origin equidistant from base of caudal and front of eye, over

cover dusky, and a slight dusky central band from below the dorsal backward on the peduncle, ill-defined more anteriorly.

Only one specimen, not well preserved. Obvious differences which it shows from its relatives in eastern China are more numerous scales, slenderer body, and dark longitudinal band, very likely quite distinct in life.

Coreius platygnathus, new species

DESCRIPTION OF TYPE.—No. 15220 American Museum of Natural History, from Chungking, Szechwan, China, altitude 750 ft., collected May, 1938, by S. W. Chang.

Length to base of caudal, 112 mm. Depth in this length, 4.4; head, 4. Eye in head, 9; snout, 2.6; interorbital, 2.5; maxillary, 2.5; width of mouth, 3.6; barbel, 1.5; width of body, 1.6; depth of peduncle, 2.5; its length, 1.2; longest dorsal ray, 1; longest anal ray, 1.4; caudal lobe, 0.8 1/2; pectoral, 0.9; ventral, 1.4.

Dorsal rays, 9; anal, 8. Scales, 56.

Head somewhat conical; body somewhat triangular, flat below; tail compressed. Snout pointed; interorbital convex; mouth horizontal, inferior, horseshoe-shaped, the maxillary ending in a membranous point which extends to under eye, this and lips posteriorly weakly papillose; lower jaw broad and flat; a single pair of long maxillary barbels which reach back about to the margin of the gill-cover; gill openings wide, gill-membranes narrowly joined to isthmus. Dorsal origin slightly in advance of that of ventral, midway between end of snout and anal axil; dorsal and pectoral falcate; pectoral reaching past ventral origin, ventrals not quite reaching vent, which is slightly before anal origin; free border of anal concave; caudal well forked, with pointed lobes. Scales with conspicuous parallel horizontal striae; breast and belly fully scaled. Colors faded, pale.

Only one specimen, quite different from *Coreius styani* with which it has been compared, and which has a narrower mouth and does not have its wide, flat lower jaw. It shows some resemblances to *Coreius zeni*

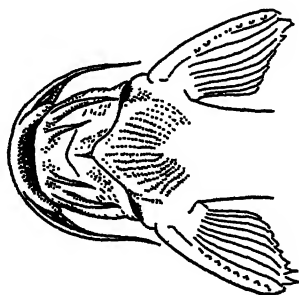


Fig. 2. *Glyptosternon punctatum*, type. Head from below.

ventral axil; pectoral not quite reaching ventral; ventral not quite reaching anal. Lateral line moderately bent down without abrupt changes in direction, rising to center of peduncle behind anal axil.

Colors faded and pale; upper part of gill-

Tchang, based on a considerably larger individual, which, however, has the dorsal, and the vent placed much more anteriorly, differences not likely to be due to size.

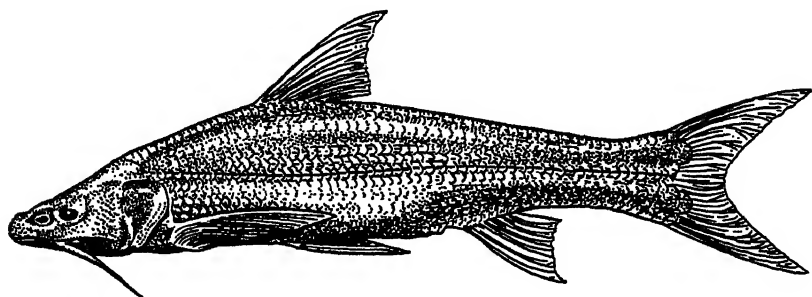


Fig. 3. *Coreius platynathus*, type. Standard length 112 mm.

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STUDIES OF PERUVIAN BIRDS. NO. XXXVI¹

THE GENERA *ELAENIA* AND *MYIOPAGIS*

BY JOHN T. ZIMMER

I am greatly indebted to Mr. Rudyerd Boulton, of Field Museum of Natural History, Chicago, and to Mr. Rodolphe de Schauensee and Mr. James M. Bond, of the Academy of Natural Sciences, Philadelphia, for the loan of various critical specimens used in the present study.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color Standards and Color Nomenclature."

Elaenia flavogaster semipagana Sclater

Elainea semipagana SCLATER, 1861, P. Z. S. London, p. 406—Bahahoyo, Ecuador; ♂; British Mus.

Eleven birds from six localities in northern Perú, west of the middle Marañón but on the eastern side of the Western Andes, are so nearly like the west-Ecuadorian *semipagana* that I believe they may be referred to it without straining its subspecific characters. They are quite readily distinguishable from typical *flavogaster*, which reaches southeastern Perú, by reason of the darker back, more sooty crest, clearer whitish throat, somewhat more grayish (less drab) chest, and frequently more grayish forehead. These characters are more strongly developed in the west-Ecuadorian birds but some of the latter are exactly like the Peruvian specimens. Not all of them have the grayish forehead, even in the Ecuadorian series.

I include in *semipagana* two skins from Barbacoas, southwestern Colombia, that are like the north-Peruvian specimens, rather closer to this form than to true *flavogaster*. Chapman (1917, Bull. Amer.

Mus. Nat. Hist., XXXVI, p. 455) assigned these birds to *flavogaster* but noted their resemblance in certain respects to *semipagana*.

It is interesting to find this western subspecies crossing the Western Andes in the manner shown by the present series. There is no form of the species found east of the Andes in Ecuador nor west of them in Perú, so far as available material and records show. This distribution is intelligible in the light of one of the theories of the geological history of this part of the Andean system. According to this explanation, the Western Andes of Perú have no direct relationship to the Western Andes of Ecuador but turn westward to the coast in two branches, the northernmost of which does not pass beyond the Sierra de Amotape. The intercordilleran belt between the Eastern and Western Andes of Perú was thus open at the northern end to access from western Ecuador, presumably before the Nudo de Sabanilla was formed, the present obstacle that now closes this gap and that may have been the leading cause that forced the waters of the Upper Marañón to find, or make, an opening eastward through the main range to the Amazonian drainage. With this history behind the present confusing picture of the mountains in northern Perú, there may have been a time when *E. f. semipagana* had an open passageway from western Ecuador to the Upper Marañón.

It is, of course, possible that *semipagana* does occur west of the Andes in extreme northwestern Perú but to have found its way over the Huancabamba Pass to the eastern side of the range, at least after the present zones were established, it would have had to enter the Subtropical Zone,

¹ Earlier numbers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 608, 703, 728, 753, 750, 757, 785, 810, 860, 861, 862, 889, 893, 894, 917, 930, 932, 933, 994, 1042, 1043, 1044, 1045, 1066, 1095.

whereas it is a species restricted to the Tropical Zone.

There is an apparently wide hiatus between the area of Perú occupied by *semipagana* and that where *flavogaster* is found, while there is fairly close connection with the ranges of the two forms in western Colombia. It is probable, therefore, that *semipagana* developed from the Colombian population of the typical subspecies.

There are no earlier records of *semipagana* from Perú except for Chapman's general inclusion of northern Perú in the range of the subspecies (1926, Bull. Amer. Mus. Nat. Hist., LV, p. 506). Records of "*pagana*" and "*flavogaster*" from northern Perú east of the Eastern Andes probably all belong with *E. spectabilis*, discussed on a later page.

***Elaenia flavogaster flavogaster* (Thunberg)**

Pipra flavogaster THUNBERG, 1822, Mém. Acad. Sci. St. Pétersb., VIII, p. 286—Brazil = Rio de Janeiro; Mus. Univ. Upsala.

Muscicapa pagana LICHTENSTEIN, 1823, Verz. Doubl. Berliner Mus., p. 54—Bahia; Berlin Mus.

Muscicapa brevirostris WIED, 1831, Beitr. Naturg. Bras., III (2), p. 799—Rio de Janeiro; ♂, ♀ cotypes in Amer. Mus. Nat. Hist.

Elaenia flavogaster macconnelli CHUBB, 1919, Ann. Mag. Nat. Hist., (9) IV, p. 304—Supenaam, British Guiana; British Mus.

Except for *E. f. semipagana* in western Ecuador, southwestern Colombia, and northwestern Perú, I can find no recognizable differentiation in the birds over the entire South American range of this species. There is, however, some confusion in eastern Brazil where the ranges of *flavogaster* and *spectabilis* appear to overlap, and although I am able to refer certain specimens to one or the other, I have a number of specimens from Rio de Janeiro and Bahia, including the male cotype of Wied's "*Muscicapa brevirostris*," that are not certainly assignable to either species. These birds are discussed more fully in the treatment of *spectabilis* on a later page.

Typical *flavogaster* reaches the southeastern part of Perú whence I have specimens from Idma and Santa Ana and records from Cosnipata and Maranura.

In Brazil, I have specimens from Cha-

pada, Matto Grosso, and several localities in the southern part of that state and one skin from Calamá, upper Rio Madeira (August), but from the Amazon I have no specimens from west of Villa Bella Imperatriz. On the other hand, my series of *spectabilis* ranges from the Ucayali in eastern Perú eastward only as far as Villa Bella Imperatriz, but southward to include Calamá and Chapada and eastward to Pernambuco. Bahia, and Rio de Janeiro. The type locality of *spectabilis* is in Goyaz. Some of the conflict in ranges may be due to migratory individuals of one or the other species, but there is some evidence that the breeding ranges also overlap. Consequently I must consider *spectabilis* as specifically distinct from *flavogaster* until workers in the field may be able to show a definite geographical or ecological segregation of the two groups.

I am not convinced of the validity of *E. f. pallididorsalis* Aldrich and Bole (1937, Sci. Publ. Cleveland Mus. Nat. Hist., VII, p. 106—Paracote, Panamá). In a series of eighty-two birds from Panamá north to Mexico, there is rather obviously darker average coloration in the birds from Costa Rica northward than in the Panamanian specimens, but I can find no clear distinctions between birds from Caribbean and Pacific Panamá while two skins from El Villano, Veraguas, Panamá, that ought to belong to the supposedly paler *pallididorsalis*, are among the darkest specimens in the entire series. Careful revision of the Central American forms is needed.

***Elaenia spectabilis spectabilis* Pelzeln**

Elaenia spectabilis PELZELN, 1868, Orn. Bras., II, p. 176—City of Goiaz; Munich Mus.

Elaenia boliviana TODD, 1913 (Aug. 8), Proc. Biol. Soc. Wash., XXVI, p. 171—Puerto Suarez, Rio Paraguay, Bolivia; ♀; Carnegie Mus.

There are at hand twenty-seven specimens that appear definitely to represent this somewhat controversial species. Most of them are from localities outside of the known range of *E. flavogaster* but some of them are from places where the other species also has been found. Certain specimens taken from November to February [Agua Blanca de Corumba (Matto Grosso),

Bello Jardim and Rio Blanco (Pernambuco), Brazil; Perico (Jujuy) and Embarcación (Salta), Argentina] are marked as with gonads at least slightly enlarged, but it is impossible to say whether these localities are within the breeding range or only in areas reached during migration, if such, indeed, takes place.

In any case, there are two other Pernambuco birds at hand (São Lourenço and Garanhuns) that cannot be separated from *flavogaster*. The Garanhuns example was taken in February, as were the two skins of *spectabilis*, although it is marked as having the gonads not enlarged and the localities are not identical. Consequently there is no certain conflict of breeding ranges of the two species although there is a strong probability of it.

The most serious part of the problem arises in connection with certain examples from Bahia and Rio de Janeiro, involving one of the cotypes of Wied's "*Muscicapa brevirostris*" (see synonymy of *E. f. flavogaster*). Before discussing these specimens, however, it may be well to give some of the results of a comparative study of the two species.

E. flavogaster flavogaster is characterized by moderately large size with wing usually not more than 80 mm. though sometimes 85.5; tail usually below 70 mm. (sometimes 76); crest long with a variable amount of white at the bases of the central feathers (sometimes none) with this white tending to extend distad along the inner margins of the feathers (not broadly and sharply truncate as in *martinica*, *gigas*, *albiceps*, *chiriquensis*, and *parvirostris*); bill distinctly broad at the base and with culmen not very sharply ridged; throat dull whitish, often tinged with drab; breast drab grayish, with yellowish flammulations; upper part of lores and a narrow eye-ring whitish, often quite pronouncedly; two broad and distinct wing-bars, often without a trace of a third but sometimes with well-marked narrow tips on the lowermost lesser coverts, forming a third bar; outer marginal stripe on inner tertials usually broad and not very sharply defined along its inner edge; outer margins of secondaries distinctly yellowish, in contrast to the mar-

gins of the primaries, but with a rather definite, dusky, quadrate speculum just beyond the lower wing-bar; bill usually brownish rather than blackish. Thirty-four males measure: wing, 71-85 mm. (av., 79.3); tail, 60-76 (av., 68.5). Twenty-five females: wing, 70-84 (av., 76.1); tail, 60-72.5 (av., 66.2).

E. spectabilis superficially resembles *flavogaster*, having the same sort of crest but with an average of less white at its base; size larger, with wing from 82 to 93 mm. and tail always 70 mm. or more, up to 86; general dorsal color averages darker than in *flavogaster*, sometimes decidedly so; bill usually blackish, averaging proportionately narrower at the base and sometimes longer; culmen appears to average more sharply ridged; throat purer white or more clearly pale grayish but without a tinge of drab; breast clearer pale gray; wing-bars always three in number with the uppermost well marked; lores and eye-ring not distinctly paler than the rest of the sides of the head; outer marginal stripe on inner tertials narrow and sharply defined; outer margins of secondaries somewhat olivaceous or dull yellowish but not so conspicuous as in *flavogaster* and with the basal dusky speculum also less pronounced. Thirteen males measure: wing, 83-93 mm. (av., 88.7); tail, 70-82.5 (av., 76.3). Nine females: wing, 82.5-89.5 (av., 87); tail, 70-77.25 (av., 73.4).

Freshly plumaged specimens of *spectabilis* and *flavogaster* can be distinguished quite readily but old, worn examples are a source of trouble. In the series before me, seven birds from the city of Bahia, three from La Raiz (near Rio de Janeiro), and the female cotype of "*Muscicapa brevirostris*" are fairly typical *flavogaster*. Another male from the city of Bahia is certainly *spectabilis* which it matches well in color though its size is inconclusive owing to the condition of molt. Another male, from Cajazeiras, Bahia, is like the Bahia male just mentioned but is larger though also in molt. A "Rio" trade-skin is in worn condition which prevents accurate comparisons of color while the size (wing, 85 mm.; tail, 75) is similarly inconclusive though the tail of this specimen is longer than I have found

in any undoubted *flavogaster*. Likewise, the male cotype of "*Muscicapa brevirostris*" is of indeterminate identity with wing, 85 mm., and tail, 74, but with plumage badly worn. Two worn trade-skins from "Bahia" resemble this Rio skin and the male cotype of "*brevirostris*" in general appearance but are much smaller (wing, 77, 77 mm.; tail, 68, 69) and on that basis must be referred to *flavogaster*. Another Rio skin, not so badly worn, is rather pale throughout, with broadly white throat but with some yellow flammulations on the chest (wing, 81.5 mm.; tail, 71).

All these dubious skins have triple wing-bars, clear white throats, little or no pale tint on the lores, and small though relatively slender bills. Their exact identity is doubtful. Only two of them, Bahia trade-skins, are sufficiently definitive in size to be referred to one of the two species, in this case *flavogaster*. Two more, from Bahia and Cajazeiras, are fresh enough to show the colors of *spectabilis*, though their size is inconclusive. The others are equivocal. If *flavogaster* and *spectabilis* were conspecific, these indeterminate specimens might be considered as simple intermediates and, in any case, may be hybrids. Longer series than I have from eastern Brazil will be required to determine the true status of the two groups. In the meantime, since any attempt to supplant *spectabilis* by the earlier name *brevirostris* (on the grounds that the male cotype of *brevirostris* shows some of the characteristics of *spectabilis*) would result in more confusion than clarity, especially since the identity of the male cotype is by no means certain, and in view of the fact that the female cotype of *brevirostris* definitely is identifiable, I hereby restrict the application of the name *brevirostris* to the form to which the female cotype belongs, thus keeping *brevirostris* in the synonymy of *flavogaster* where it has been for many years.

The specimen from Ocampo, Argentina, recorded by Hartert and Venturi (1909, Novit. Zool., XVI, p. 199) as *E. f. flavogaster*, I place, rather, in *spectabilis*. Venturi records eggs collected on December 2.

Three specimens from Campos Salles,

near Manaos, Brazil, are the only examples at hand from north of the Amazon, although Pelzeln found the species at Barcellos, also on the Rio Negro, in August. The Campos Salles birds also were collected in August. A Tefé bird is dated July; one from Sarayacu, Perú, April; five Rio Madeiran birds, April, and one, August; two Villa Bella Imperatriz, August; three Chapada, Matto Grosso, May, September, and no date; one Agua Blanca de Corumbá, November; one Ceará specimen, November; six north-Argentine birds, January and February.

These dates strongly suggest the possibility that *spectabilis* breeds only in the southern part of its range and in the elevated campos northeastward as far as Pernambuco and that it visits the Amazonian region only as a migrant. Field studies will be needed to confirm this supposition. Conflict with *flavogaster* in breeding range has yet to be established.

Peruvian records tentatively assigned to *spectabilis* are from Chamicuros, Chayavitas, Huayabamba, and Jeberos and I follow Hellmayr's assignment of Pebas, Nauta, Moyobamba, Chirimoto, and Puerto Arturo (Yurimaguas).

I have used a trinomial for this species since I believe that *Elainea* (sic) *ridleyana* Sharpe (1888, P. Z. S. London, p. 107—Fernando Noronha) is a subspecies of *spectabilis* instead of *chiriquensis*. Seven skins from Fernando Noronha are darker and a little duller on the anterior under parts than mainland specimens of *spectabilis* but above are very like the darker mainland birds; lores and circumocular area dark; the bills also are darker and even more slender but equally long, and the wing and tail are within the measurements of true *spectabilis* (males: wing, 86–88 mm.; tail, 70.5–76.5; females: wing, 81–85.5; tail, 85.5–72); there are three well-marked wing-bars; the development of the crest and its basal white area approximates that of *spectabilis*. Since *E. s. spectabilis* reaches Pernambuco there is at least as close an approximation of ranges as was the case when *ridleyana* was considered as a form of *chiriquensis*.

SPECIMENS EXAMINED

E. f. flavogaster.—

BRAZIL:

- São Paulo, Victoria, 3 ♂, 2 ♀;
 Itararé, 1 ♂;
 Bauru, 1 ♂;
 Avanhandava, 1 ♀;
 Espírito Santo, Lagoa Juparaná, 3 ♂, 3 ♀;
 Minas Gerais, Rio Jordão, 1 ♂, 1 ♀;
 Rio Caparão, 1 ♂;
 Bahia, Bahia, 3 ♂, 4 ♀, 1 (?);
 Cajazeiras, 2 (?);
 "Bahia" (trade-skins), 2 (?);
 Rio de Janeiro, La Raiz, 2 ♂, 2 ♀;
 [Rio de Janeiro], 1 ♀ (cotype of *Muscicapa brevirostris*);
 Pernambuco, São Lourenço, 1 ♂;
 Garanhuns, 1 ♀;
 Maranhão, Anil, 1 ♂;
 Piauí, Corrente, 1 ♂, 1 ♀;
 Teresina, 1 ♀;
 Matto Grosso, Chapada, 18 ♂, 10 ♀, 4 (?);
 Juruena, 1 ♂;
 Tapirapóan, 1 ♂;
 Rio Madeira, Calamá, 1 (?);
 Rio Amazonas, Villa Bella Imperatriz, 3 ♂, 2 ♀;
 Rio Tapajoz, Tauary, 6 ♂, 5 ♀;
 Aramanay, 1 ♀;
 Santarem, 1 ♂;
 Rio Xingú, Porto de Moz, 4 ♂, 3 ♀;
 Rio Tocantins, Baíão, 1 ♂, 1 ♀;
 Rio Jamundá, Faro, 4 ♂, 8 ♀;
 Rio Branco, Caracarahy, 1 ♂;
 Rio Cotinga, Limão, 1 ♀.

PARAGUAY:

- Escobar, 1 ♂;
 east of Caaguassú, 2 ♂, 1 ♀.

PERU:

- Idma, 1 ♂;
 Santa Ana, 3 ♂, 5 ♀.

BRITISH GUIANA:

- Rockstone, 1 ♂, 1 ♀;
 Wisnar, 1 ♂, 1 ♀;
 Annai, 1 ♂;
 "British Guiana," 1 (?).

DUTCH GUIANA:

- near Paramaribo, 5 ♂, 6 ♀.

FRENCH GUIANA:

- Cayenne, 5 ♂, 3 ♀;
 Roche Marie, 3 ♂;
 Isle Le Pére, 1 ♀.

TRINIDAD:

- (Caparo, Waterloo, Savanna Grande, Carénage, heights of Aripo, La Brea, Princes-town, Leelet, Pointe Gourde, and "Trinidad"), 8 ♂, 10 ♀, 1 (?).

TOBAGO:

- (Plymouth, Mondiland, and Lecito), 2 ♂, 7 ♀.

GRANADA:

- 1 ♂, 1 ♀.

ST. VINCENT:

- (Boquié, Kingston, Wallilabo, and "Valley"), 3 ♂, 2 ♀, 2 (?).

VENEZUELA:

- Cumanacoa, 3 ♀;
 Cumaná, Campos Alegre Valley, 1 ♂, 1 ♀, 1 (?);
 Río Orinoco, Altagracia, 2 ♂, 2 ♀;
 Caicara, 3 ♂, 2 ♀;
 Agua Salada de Ciudad Bolívar, 3 ♀;
 Ciudad Bolívar, 2 ♂, 5 ♀;
 Suapure, 1 ♂, 3 ♀;
 Río Caura, Maripa, 4 ♂;
 La Prición, 1 ♂;
 Mt. Roraima, Paulo, 1 ♂;
 Mt. Roraima, Philipp Camp, 1 ♀.

COLOMBIA:

- (northern Antioquia, Choachi, Tenasuca, Los Cisneros, San Antonio, Las Lomitas, El Consuelo, El Carmen, Primavera, Río Frío, Chicoral, Popayan, Boca de Chimi, Andalucía, Honda, Cali, Quitame, east of Palmira, Caldas, Mambito, "Bogotá," Río Magdalena, Calamar, Minca, Donama, Cacagualito, and Bonda), 22 ♂, 23 ♀, 20 (?).

E. f. semipagana.—

COLOMBIA:

- Barbacoas, 2 ♂.

ECUADOR:

- (Esmeraldas, Santa Rosa, Hacienda Ana Maria Quevedo, Paramba, Duran, Zaruma, coast of Manaví, Manaví, Río Pindo, Portovelo, Chone, and Puna Island), 11 ♂, 5 ♀, 2 (?).

PERU:

- Perico, 2 ♀;
 Pucará, 2 ♂;
 Cabico, 1 ♀;
 Jaen, 2 ♂, 1 ♀;
 Huarandosa, 1 ♂, 1 ♀;
 Tamborapa, 1 ♂.

E. s. spectabilis.—

BRAZIL:

- Rio Negro, Campos Salles, 1 ♂, 2 ♀;
 Rio Amazonas, Teffé, 1 ♀;
 Villa Bella Imperatriz, 1 ♂, 1 (?);
 Rio Madeira, Santo Antonio de Guajará, 3 ♂, 1 ♀;
 Calamá, 1 (?);
 Rio Tapajoz, Inajatuba, 1 ♂;
 Porto Velho, 1 ♀;
 Matto Grosso, Chapada, 2 ♀, 1 (?);
 Agua Blanca de Corumbá, 1 ♂;
 Bahia, Cajazeiras, 1 ♂;
 Bahia, 1 ♂;
 "Rio de Janeiro" (trade-skin), 1 (?);
 Ceará, Viçosa, 1 ♂;
 Pernambuco, Rio Branco, 1 ♂;
 Bello Jardim, 1 (?).

ARGENTINA:

- Santa Fé, Ocampo, 1 ♂;
 Salta, Embarcación, 4 ♂, 1 ♀;
 Jujuy, Perico, 1 ♂.

PERU:

- Sarayacu, 1 ♂.

E. s. ridleyana.—

BRAZIL:

- Fernando do Noronha, Borodó, 1 ♀;

Villa, 2 ♂;
The Peak, 1 ♂;
Quixaba, 1 ♂, 2 ♀.

Elaenia species incert.—

BRAZIL:

"Bahia" (trade-skin), 1 (?);
"Rio" (trade-skin), 1 (?);
Rio de Janeiro, 1 ♂ (cotype of *Muscicapa
brevirostris*).

***Elaenia albiceps albiceps* (D'Orbigny and Lafresnaye)**

Muscipeta albiceps D'ORBIGNY and LAFRESNAYE, 1837, Mag. Zool., VII, Cl. 2, "Syn. Av.," p. 47—part., Yungas, Bolivia; cotypes in Paris Mus.

The nominate subspecies of *albiceps* is a relatively large form, relatively dark brown above, with broad and moderately well-defined and pale edges on the tertials, moderately prominent pale eye-ring and lores, brownish-gray chest and white belly rather contrasting with the greenish flanks, and with the concealed white area on the crown subterminally tinged with brownish.

There is a great deal of resemblance to *E. a. griseogularis* of Ecuador and no clear distinction in some examples although *albiceps* may have a longer crest, on average, with more extensive white at its base, and appears to have a more distinct pale eye-ring. Many examples of *griseogularis* are lighter on the back than my two specimens of *albiceps* but others are not and both forms have the white area on the crest tinged with brown toward the tips.

A male from Santo Domingo, Perú, differs from the two Bolivian birds at hand by having the throat and chest dingy grayish brown, but the general dorsal coloration is quite dark, the belly is white, and the whole appearance of the specimen more like *albiceps* than any other form of the species. This, together with the nearness of locality, induces me to place this specimen in *albiceps*.

***Elaenia albiceps urubambae*, new subspecies**

TYPE from Chospiyoc, Urubamba Valley, Perú; altitude 10,000 feet. No. 305,831, American Museum of Natural History. Adult male "breeding" collected April 21, 1915, by Edmund Heller; original No. 44.

DIAGNOSIS.—Similar to *E. a. albiceps* of northern Bolivia but with upper parts paler brown; sides of head more uniform (without as promi-

nent pale eye-ring and pale lores); flanks duller and less greenish; belly yellowish, not pure white; wing-bars duller and less sharply defined; bill apparently heavier. Differs from *E. a. chilensis* of southern Chile by more brownish, less olivaceous, upper parts; concealed patch at base of crest less purely white; sides of head more uniform in color; under parts more yellowish on the belly, duller and less greenish on the flanks; bill stronger. Somewhat resembles *E. modesta* of the coastal region of Perú in respect to reduced prominence of wing-bars but the bars are not so weak as in *modesta* and have the lower bar formed of rather definite, quadrate terminal spots on the outer webs of the greater wing-coverts, not merely of pale termino-marginal lines; a more obvious blackish "speculum" on the outer margins of the secondaries beyond the tips of the greater wing-coverts; under parts more yellowish, not ashy gray and white; maxilla more blackish brown; general plumage coarser, especially on the under parts.

RANGE.—Apparently restricted to the Urubamba Valley, Perú.

DESCRIPTION OF TYPE.—Upper parts dark Buffy Brown, the top of the head somewhat darker than the back; feathers of crown elongated to form a distinct, bifurcate crest with a large, barely concealed patch of yellowish white on the basal part of the central feathers, reaching to the tips of a few of the shorter, posterior plumes; sides of head a little paler brown than the back and with a faint suggestion of still lighter color around the eye and on the lores; throat pale Olive-Buff with chin a little whiter; chest a little darker, approaching the color of the back on the sides of the breast; belly Ivory Yellow with suggestions of brighter yellow flammulations; extreme lower part of belly medially more whitish, largely concealed; flanks broadly Dark Olive-Buff × Deep Grayish Olive; shorter under tail-coverts like the belly but longer ones largely Deep Grayish Olive with Ivory Yellow margins. Wings dark brown; primaries narrowly margined externally with Pale Olive-Buff, obsolete toward the tips; secondaries with median portion of outer margins dull Sea-foam Yellow, becoming whitish distally and with basal portion dusky, forming a squarish "speculum"; lesser upper wing-coverts like the back; median and greater series dark brown with rather inconspicuous paler terminal markings forming two wing-bars; the markings on the median series are Light Grayish Olive and cross both webs of the feathers at their tips; those on the greater series are slightly lighter in tone and cross the outer web only, meeting the shaft broadly; tertials like inner secondaries but with broader white at the tips of the outer webs; innermost tertial with whole outer web paler than inner web, palest along outer margin; under wing-coverts Dark Olive-Buff × Deep Olive-Buff; inner margins of remiges narrowly dull buffy whitish; tail dark brown with indistinctly pale, narrow tips and with outer margins of rec-

trices brownish olive. Maxilla (in dried skin) dark brown; mandible brownish buff; feet dark brown. Wing, 84 mm.; tail, 74; exposed culmen, 10.24; culmen from base, 14.25; tarsus, 21.

REMARKS.—Female like the male but smaller; wing, 74.5–79 mm. (av., 77); tail, 64.5–73 (av., 68.7); in males, wing, 79.5–85 (av., 81.1); tail, 69–74 (av. 71.2).

Five adult examples in the series are even yellower on the under parts than the type; the remainder are about like the type. The series, as a whole, presents a uniform appearance that is in decided contrast to the other subspecies, all of which have the belly white except for certain individuals whose cases are discussed elsewhere.

Elaenia albiceps griseogularis Sclater

Elaenia griseogularis SCLATER, 1858, P. Z. S. London, XXVI, p. 554, Pl. CXLVI, fig. 1—Riobamba, Ecuador; British Mus.

As noted under *E. a. albiceps*, the present form is not profoundly different from the typical subspecies. It averages very slightly lighter on the upper parts, has less of a pale eye-ring, and usually has a shorter crest with less white at the base, but some specimens come very close to *albiceps*.

This form ranges down the Andes from northern Ecuador to northern Perú, being found in the Eastern Andes of northern Ecuador but occurring only in the western side of the Western Andes in southern Ecuador and northwestern Perú. Birds from this southern district are not clearly distinguishable from northern birds although there are certain individual specimens that show a surprising tendency toward the characters of *Elaenia pallatangae*, which occurs in the same region and which may hybridize with it.

Typical *griseogularis* is easily distinguishable from typical *pallatangae* by several characters. *Pallatangae* has the under parts largely bright lemon yellow, with the flanks olivaceous, sometimes with a slight shading across the chest and less often with the throat somewhat whitish; the under tail-coverts also are yellow and rarely show any prominent, dark central areas on these feathers. *Griseogularis* has the belly white, with the olive green of the flanks in rather marked contrast, the chest gray, the throat pale gray, and the under

tail-coverts, at least the longer ones, brownish with narrow pale edges. *Pallatangae* has the back olive brown, the wings blackish with the wing-bars relatively narrow though well defined, nearly the whole outer web of the inner tertial whitish, and the white mark at the tip of the outer web of the second tertial relatively broad. *Griseogularis* usually is less olive and more brownish above, the wing-bars are broader and not so clear, the inner tertial has the outer web paler than the inner but not white except perhaps along the outer margin, and the pale marking on the second tertial is narrow or, if broad, is not so sharply defined. *Pallatangae*, furthermore, has a well-defined yellow eye-ring and pale loreal spot, both of which are much less obvious in *griseogularis*, usually quite inconspicuous or obsolete. *Griseogularis* averages larger than the other species. The coronal patch of *pallatangae* is usually whiter.

In a small series of specimens from El Paso (near Nabon), Taraguacocha, San Bartolo, Sabanilla, and Zamora, a tentative division may be made on an arbitrary line drawn on the basis of the yellowness of the belly. The other characters are mixed. The single Taraguacocha bird is nearly typical *griseogularis* except for rather pronounced pale eye-ring and lores, not so yellowish as in *pallatangae*. Two San Bartolo females have the median under parts more whitish than yellowish though the breasts have a greenish tinge and the wing-markings are like those of *pallatangae*: one bird has prominent eye-ring and lores, the other does not. A male from the same locality is rather definitely *pallatangae*. Two birds from Zamora and three from Sabanilla appear to belong to *pallatangae* although one of the Sabanilla specimens has an unusually whitish throat and traces of white along the median line of the belly and another Sabanilla specimen is as strongly yellow beneath as any in the series of *pallatangae*. The El Paso birds are nearest to *griseogularis*.

There is little possibility of considering *pallatangae* as belonging to the *albiceps* group. Although, for the most part, the specimens of each at hand were taken in

different localities, some of them are from the same localities as at Torontoy, Urubamba Valley, Perú, whence I have a male of *pallatangae* and a male of *albiceps urubambae*, both quite typical. Nevertheless, as stated in a previous paragraph, some hybridization is probable.

Among the northwest-Peruvian specimens, a young bird from Chugur, whence I have other *griseogularis* but no certain *pallatangae*, has a greenish-yellow tinge on the under parts and broad white outer web of the inner tertials that suggests its possible hybrid origin. Another young bird from the same place is much whiter underneath but it, too, has broad white on the tertials. The three adults from Chugur vary among themselves though none is referable to *pallatangae*.

One male from Alamor is very dark on the upper surface and very like typical *albiceps* except that the whitish coronal patch is more limited in extent. A male from Taulis, on the other hand, has an unusually large coronal patch though its general coloration is normal for *griseogularis*. Another Taulis skin has the coronal patch of normal size.

Across the Western Andes of Perú, on the eastern side of the cordillera a little to the southward, the greater extent of the light coronal patch becomes a regular feature, combined with certain other characters, and it appears desirable to recognize a separate subspecies for the birds of this region. This form may be known as follows.

Elaenia albiceps diversa, new subspecies

TYPE from Cajabamba, northern Perú; altitude 9000 feet. No. 499,426, American Museum of Natural History. Adult male collected in January, 1894, by O. T. Baron.

DIAGNOSIS.—Similar to *E. a. griseogularis* of Ecuador but throat whiter, chest grayer, and wing-bars distinctly less sharply marked though prominent; concealed white patch at the bases of the crest-feathers more extensive, usually markedly so; color of upper surface averaging paler. Differs from *E. a. albiceps* of northern Bolivia by paler upper parts, heavier bill, somewhat less strongly pronounced wing-bars, and less obvious eye-ring. Differs from *E. a. urubambae* of the Urubamba Valley, Perú, by whiter throat and belly and stronger wing-bars.

RANGE.—Subtropical Zone. Central and eastern side of Western Andes of northern Perú.

DESCRIPTION OF TYPE.—Upper parts Brownish Olive \times Deep Olive; top of head a little darker with a bifurcate crest enclosing a large, concealed area of dull whitish, tinged with brownish subterminally and reaching the tips of some of the central-posterior feathers; sides of head a little paler than the back with lores and narrow eye-ring inconspicuously still paler; chin and throat whitish in some contrast to the chest which is Smoke Gray medially and brownish laterally, with slight traces of greenish-yellow flammulations in the middle; belly broadly white, with some yellowish flammulations laterally adjoining the Citrine-Drab flanks; under tail-coverts olive brownish with narrow pale margins. Wings as in *E. a. urubambae* except that the wing-bars and outer web of inner tertial are paler and somewhat better defined. Tail as described for *E. a. urubambae*; bill and feet as in the Urubamba form though bill is of smaller dimensions. Wing, 83.5 mm.; tail, 75.5; exposed culmen, 8.75; culmen from base, 13; tarsus, 20.

REMARKS.—Female not certainly known although, of the specimens at hand, two sexed as males are smaller than the others and may be wrongly sexed while of two birds without given sex, the smaller one also may be a female. These three questionable specimens have the wing, 76.5, 77, and 78 mm.; tail, 67, 70.5, and 73, respectively. The remainder, probably all males, have the wing, 81, 82.1, 83, and 83.5; tail, 73, 76, 73, and 75.5, respectively.

On the other hand, all these measurements, including those of the possible females, are above the minimum measurements of the males of *griseogularis* but below the maximum measurements of male *urubambae*. It is probable, therefore, that *diversa* is regularly intermediate in size between the Ecuadorian and Urubamban forms.

Elaenia albiceps chilensis Hellmayr

Elaenia albiceps chilensis HELLMAYR, 1927 (April 11), Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 413—Curacautin, Prov. Malleco, Chile; ♂; Field Mus. Nat. Hist.

As has been pointed out by various authors, the form of *albiceps* that breeds throughout most of lowland Chile, migrates somewhere in February and March, or April, returning in September and October to nest from November to February. Hellmayr (*loc. cit.*) doubted the supposition

that the birds migrated to the northward although he could offer no conjecture as to their non-breeding range.

As a matter of fact the birds do go northward and spend the southern winter in an extensive area from Perú to the eastern coast of Brazil and north to the Amazon, occasionally well north of it. A good series of birds from various parts of Perú, Bolivia, and Brazil, from Matto Grosso east to Bahia and Rio de Janeiro and north to the lower Rio Tapajoz show dates of collection from March to October (one skin from Urucum, Brazil, is dated November 26). Chilean and Argentine birds are dated from October to February, with certain December and January examples marked as breeding.

The migrants taken in their winter range agree with the Chilean specimens, showing extremes of freshness (October) and wear (March) with molt in the intervening period. The slender bill, dull chest, narrow but sharply defined wing-bars, relatively pure white coronal patch, usually with decidedly blackish areas on the feathers laterally adjacent, obvious pale lores and eye-ring, and characteristic wing-formula all identify these birds as *chilensis*. The wing-formula appears to have escaped observation but is a very good criterion for the recognition of the subspecies. In the non-migratory forms of *albiceps*, the tenth (outermost) primary is shorter than the fifth but in *chilensis* it is almost always longer. As frequently happens, the form accustomed to make long journeys has a more pointed wing than the forms of more stationary habits. There is no evidence of the migration of *chilensis* northward along the coast into Perú but only along, or over, the chain of the Andes. All the related birds from the coast of Perú are *E. modesta*.

A female from Tenasuca, above La Mesa, Colombia, is doubtfully referred here. It agrees with Chilean birds in color and size and differs only by reason of the outermost primary which is a little shorter than the fifth. However, the wings are in molt and have the fifth primaries fresh, the tenth of the left wing old though not badly worn, and the tenth of the right wing missing. Consequently the evidence is not conclusive

that the wing-formula of this individual would not have been correct for *chilensis* when fully plumaged.

Elaenia modesta Tschudi

E(elaenia) modesta TSCHUDI, 1844 (May). Arch. Naturg., X (1), p. 274—Perú; I suggest Lima; Mus. Neuchâtel.

The specific association of this bird with *albiceps* is not perfectly certain for several reasons. The various members of the *albiceps* group (*sensu strictu*) are inhabitants of the Temperate lowlands of Chile and the Temperate Zone of the Andes of more northern countries, or at most the Subtropical Zone, whereas *modesta* lives in the Arid Tropical Zone of the coast of Perú (and perhaps northern Chile) though it is found, at least at certain seasons, in portions of the Chinchipe, Huallaga, and Chanchamayo valleys and, in one case, has been found at the same locality as *albiceps diversus*.

Typical *modesta* is fairly easily distinguishable from the members of the *albiceps* group. The latter have broad and relatively well-marked wing-bars on a blackish or dusky ground with the lowermost bar composed of quadrate terminal spots on the outer webs of the greater wing-coverts. The inner tertial has a broadly whitish area on the outer web and there is a conspicuous blackish patch on the outer webs of the secondaries just beyond the greater wing-coverts. *Modesta* has the wing-bars, particularly the lower one, less conspicuous, with the lower one composed mostly of a pale marginal line on the greater coverts. The inner tertial is but faintly paler on the outer web than on the inner and is never broadly whitish while the basal portion of the outer webs of the secondaries is rarely conspicuously dark. *Modesta* has the lores and circumocular space dull and little if any paler than the adjacent areas while the remaining forms under discussion have more or less obvious pale lores and a pale eye-ring, sometimes quite marked. *Modesta* usually has more obvious dark centers and pale edges on the feathers of the top of the head giving a more speckled appearance than in the other forms in question. *Modesta* appears to have somewhat more com-

pact plumage than the others and is a paler and duller bird in nearly all respects.

These characters vary slightly but there are very few specimens that cannot be placed with certainty. Nevertheless, there is an occasional tendency in the direction of the characters of the highland forms sufficient to indicate the probable specific affinity. The principal obstacle to specific union lies in the apparent confusion of ranges. This difficulty, however, is not without a possible solution.

Slater (1866, P. Z. S. London, p. 99) quotes Professor Nation to the effect that *modesta* leaves the vicinity of Lima in June and returns in December. The series before me shows the breeding of *modesta* at Lima in January and February. Furthermore, all the birds from the western coast were collected from December to July while all of the relatively limited series from interior localities were taken from May to December. It seems probable, therefore, that *modesta* leaves the coast for the interior after the breeding season and returns in time for the next nuptial period.

Such migratory movement of a purely tropical species would be unusual; at least it is a sort of which we have much to learn. The movement would take the birds away from the arid coast at about the time of the commencement of the annual *garua* or mist, marking the season of the most abundant vegetational growth of the year, and would carry them to the most arid portions of the interior at the driest periods for those regions. Decidedly, therefore, more data are required to confirm this apparent migration before it may be accepted as fact. In the meantime, it may be unsafe to continue the specific union of *modesta* with the *albiceps* group and, accordingly, I have given it specific rank.

Due to the confusion that has existed in the present genus, it is impossible to assign Peruvian records to their proper places except where the critical specimens have been reexamined.

SPECIMENS EXAMINED

E. a. chilensis.—

CHILE:

(Tofo, False Cape Horn, Punta Arenas, Londonderry Is., Río Blanco, Puerto

Montt, Corral, Valparaíso, Los Andes, Isla Mocha, Maquehué, Chiloe Is., Concepción), 18 ♂, 13 ♀, 3 (?).

ARGENTINA:

(Chubut, Fuerte de Andagala, Paraná, Flores, Cosquin, Mendoza, and above San Pablo), 7 ♂, 2 ♀, 1 (?).

BOLIVIA:

La Paz, Tucunguaya, 1 ♂;
Sara, Camp Woods, 1 ♀.

PARAGUAY:

east of Villa Rica, 3 ♂, 2 ♀.

BRAZIL:

Matto Grosso, Chapada, 3 ♂, 2 ♀;
Urucum, 1 ♂;
Rio de Janeiro, Maceiras, 4 ♂, 1 ♀;
Ponte Maromba, 1 ♂;
Bahia, Bahia, 1 ♂;
Rio Grando do Sul, Nonohay, 1 ♂, 1 ♀;
Rio Tapajoz, Igarapé Brabo, 1 ♂;
Piquiatuba, 1 (?).

PERU:

La Pampa, 1 ♂;
Tulumayo, 1 ♂;
Pozuzo, 2 ♂;
Huánuco, 2 ♂¹;
Huachipa, 1 ♀¹;
Perico, 1 ♀;
San Ignacio, 3 ♂, 1 ♀, 1 (?);
Moyobamba, 2 ♂¹, 5 ♀¹.

COLOMBIA:

Tonasuca, 1 ♀.

E. a. albiceps.—

BOLIVIA:

Incachaca, 2 ♀.

PERU:

Santo Domingo, 1 ♂.

E. a. urubambae.—

PERU:

Chospiyoc, 2 ♂ (incl. type);
Pisac, 4 ♂, 2 ♀, 1 (?);
Torontoy, 1 ♂;
San Miguel, 1 ♂;
San Miguel Bridge, 1 ♀;
Huiro, 1 [♂].

E. a. diversa.—

PERU:

Chusgon, 1 "♂";
Cajabamba, 3 ♂ (incl. type), 1 "♂" [♀ = ♀];
Tayabamba, 2 (?);
Huachipa, 1 ♂¹, 2 ♀¹;
Vista Alegre, 1 ♂¹, 2 ♀¹;
Chinchao, 1 ♂¹;
Huánuco, 1 ♂¹, 1 ♀¹;
Culcui, 1 ♂¹.

E. a. griseogularis.—

PERU:

Taulis, 2 ♂;
Seques, 1 ♂;
Chugur, 2 ♂, 2 ♀, 1 (?);

¹ Specimens in Field Museum of Natural History, Chicago.

Palambra, 2 ♂, 1 ♀;

Alamor, 1 ♂.

ECUADOR:

Gualea, 1 ♂;

Mt. Pichincha, 3 ♂, 3 ♀;

above Baeza, 3 ♂;

Oyacachi, 1 ♂, 1 ♀;

Cayambe Mts., 1 ♂;

Papallacta, 2 ♂;

Ibarra, 2 ♂;

Taraguacocha, 1 ♂;

Yanacocha, 1 ♀;

"Guayaquil," 1 (?);

"Ecuador," 2 (?);

near Nabon, 2 ♂, 2 ♀;

San Bartolo, 2 ♀.

E. modesta.—

PERÚ:

Vitor, 4 ♂, 4 ♀, 1 (?);

Ilo, 2 ♂;

Moquegua, 5 ♂, 1 ♀;

Ica, 1 ♂;

Lima, 5 ♂, 1 ♀, 1 (?);

Chosica, 1 ♂¹, 2 ♀¹;

Vitarte, 1 ♂, 2 ♀;

Sayan, 1 ♂;

Huacho, 11 ♂, 3 ♀, 1 (?);

Huaral, 4 ♂, 4 ♀;

Santa Eulalia, 1 ♂¹;

Poroto, 1 ♂;

Virú, 1 ♂, 3 ♀, 1 (?);

Trujillo, 1 ♂;

Huarandosa, 1 ♀;

Nuevo Loreto, 1 (?);

Vista Alegre, 1 ♀¹;

Moyobamba, 2 ♂¹, 1 ♀¹;

La Merced, 1 ♀;

Tulumayo, 2 ♂, 1 ♀;

Perené, 1 ♂.

Elaenia parvirostris Pelzeln

Elaenia parvirostris (sic) PELZELN, 1868, Orn. Bras., II, p. 178—Curytiba, Borba, and Barcellos, Brazil; type from Curytiba in Vienna Mus.

Elaenia hypospodia SCLATER, 1887, P. Z. S. London, p. 49—Valencia, Venezuela; ♂; British Mus.

Elaenia albiventris CHAPMAN, 1897, Auk, XIV, p. 368—Cumanacoa, Bermúdez, Venezuela; ♂; Amer. Mus. Nat. Hist.

? *Elaenia archaetata* BERTONI, 1901, Av. Nuev. Parag., p. 119—Alto Paraná, Paraguay.

Elaenia aenigma STRESEMANN, 1937 (May 2), Orn. Monatsb., XLV (3), p. 75—Mt. Illiniza, Ecuador; ♂; Berlin Mus.

This species appears to be migratory in habit, breeding in the latitude of northern Argentina some time about the end of January, leaving for the north, probably in March, and returning in September and

October. A series of one hundred and fourteen specimens now before me shows twenty-nine out of thirty Argentine specimens to have been taken from October 17 to February 1 (one La Plata skin is dated May). Ten birds from the state of Rio Grande do Sul, Brazil, are dated from October 9 to December 14; two Paraguayan skins, October 13 and 21; one Uruguayan bird is dated November 12. One specimen from southeastern Perú (La Pampa) is dated November 23. The remainder of the series from regions as far north as northern Venezuela and Santa Marta, Colombia, shows dates only from April 8 to October 20. Berlepsch and Hartert (1902, Novit. Zool., IX, p. 44) and Cherrie [1916, Sci. Bull. Mus. Brookl. Inst. Arts. Sci., II (6), p. 229] describe the nest and eggs of a species identified by them as *parvirostris*, taken by Cherrie at Caicara, Venezuela, on April 2, but although *parvirostris* was collected at Caicara in May and June, the female taken with the nest and eggs in question, belongs to *E. chiriquensis albivertex*. There is no evidence of *parvirostris* breeding in Venezuela or elsewhere in northern South America. The late November specimen from southeastern Perú may be no more than a belated migrant.

All the Argentine and other southern birds are in various stages of simple wear of their plumage. October and November birds are relatively fresh; January and February specimens often badly worn. The northern birds that I consider as migrants show various stages of molt, mostly advanced (wing and tail) and possibly largely post-juvinal. Even April and May birds are fairly fresh and none are ragged like the January specimens from Argentina. The annual molt may proceed rapidly during March, a month not represented in the series at hand.

One male from Buena Vista, Río Cassiquiare, Venezuela, taken May 1, 1929, lacks the lipochrom tints and appears clearer gray and white, presumably like the type of Sclater's "*Elaenia hypospodia*."

The type of *Elaenia aenigma* Stresemann, kindly sent me by the describer for examination, proved to be *parvirostris*, the first to be found in Ecuador. The migra-

¹ Specimens in Field Museum of Natural History, Chicago.

tion route of the species appears to be largely east of the Andes and consequently Andean records are not numerous. Aside from the two birds now before me from southeastern Perú, there are records only from Xeberos, Chayavitas, and Pebas, originally published under *E. modesta* and *E. albiceps* and included in the present account only on the authority of Hellmayr who has examined the Pebas and Chayavitas specimens. Owing to the great confusion that has existed in the genus *Elaenia*, records by early authors cannot be assigned with certainty.

SPECIMENS EXAMINED

E. parvirostris.—

ARGENTINA:

- Salta, Arenal, 1 ♀;
- Embarcación, 6 ♂, 3 ♀, 1 (?);
- Rosario de Lerma, 3 ♂;
- Santa Fé, Ocampo, 1 ♂, 1 ♀;
- Tucumán, Tapia, 2 ♂, 1 ♀;
- Las Vasquez, 1 ♂;
- Barracas al Sud, 1 ♂, 1 ♀;
- Entrerios, La Soledad, 1 ♂, 1 ♀;
- Buenos Aires, 2 ♂, 1 ♀;
- La Plata, 1 ♂;
- Flores, 1 ♂, 1 ♀.

URUGUAY:

- mouth of Río Jaguarão, 1 ♀.

PARAGUAY:

- Colonia Independencia, 2 ♂.

BRAZIL:

- "Bahia," 1 (?);
- Rio Grande do Sul, Palmares, 1 ♂;
- Paccaria, 1 ♂;
- west of São Lourenço, 1 ♂, 1 ♀;
- Santa Isabel, 1 ♂, 1 ♀;
- Lagôa dos Patos, 1 ♂;
- Palmares, 1 ♂, 1 ♀;
- São Francisco de Paula, 1 ♀;
- Matto Grosso, Chapada, 2 ♂;
- Rio Roosevelt, Carapaña, 1 ♀;
- Rio Madeira, Borba, 1 ♂;
- Rosarinho, 1 ♀;
- Santo Antonio de Guajará, 1 ♂;
- Rio Amazonas, Teffé, 3 ♂, 1 ♀, 1 (?);
- Rio Tapajoz, Santarem, 1 ♀;
- Piquiatuba, 1 ♂;
- Caxiricatuba, 1 ♂;
- Rio Negro, Santa Maria, 1 ♀;
- São Gabriel, 1 ♂, 3 ♀;
- Yavanari, 2 ♂, 1 ♀;
- Tatú, 1 ♂, 1 ♀;
- Mt. Curycuryari, 2 ♂, 1 ♀;
- Yucabí, 3 ♀.

VENEZUELA:

- Río Huaynia, junction of the Cassiquiare, 1 ♀;
- Río Cassiquiare, Solano, 1 ♀;
- Buena Vista, 8 ♂, 2 ♀, 1 (?);

- Río Orinoco, opposite mouth of Ocamo, 1 ♂;
- Caicara, 1 ♂, 3 ♀;
- Las Barrancas, 1 ♂, 1 ♀;
- Quiribana de Caicara, 1 ♀;
- Puerto Cabello, 1 ♂;
- Cristóbal Colón, 1 ♀;
- Cumanacoa, Bermúdez, 1 ♂ (type of *albinensis*), 2 ♀;
- Mérida, Escorial, 1 ♂, 1 ♀;
- "Venezuela," 1 (?).

COLOMBIA:

- Santa Marta, 3 (?);
- Florencia, 1 ♂, 3 ♀, 1 (?),
- "Bogotá," 1 (?).

PERU:

- La Pampa, 1 ♂;
- Río Inambari, 1 ♀.

ECUADOR:

- Mt. Illiniza, 1 ♂.

Elaenia strepera Cabanis

Elainea strepera CABANIS, 1883, Jour. für Orn., XXXI, p. 215—foothills of Tucumán, Argentina; Berlin Mus.

A female from Santa Rosa, upper Río Ucayali, adds a species to the Peruvian list and gives an extension of range to this imperfectly understood bird. A young male from Cristóbal Colón, northern Venezuela, adds still another locality to the specific range, although there are three other known specimens in existence from Venezuela (El Callo, San German de Upata, and an "Orinoco" skin).

Of five birds at hand from the Province of Tucumán, Argentina, four are dated October 28, December 24, December 25, and January 23; the fifth is undated. The Peruvian specimen was taken on November 13; the Cristóbal Colón specimen, May 30; the El Callo bird said to have been collected May 10; the San German de Upata skin, June 2. These dates add weight to Dinelli's assertion, quoted by Hartert and Venturi (1909, Novit. Zool., XVI, p. 199) that the species is migratory, arriving in the neighborhood of Tucumán in the southern spring to breed locally and leaving in the fall. I am confident that the Peruvian and Venezuelan records all concern migrants *en route* or in their winter homes.

Elaenia gigas Selater

Elainea gigas SELATER 1871 (about March), P. Z. S. London for 1870, p. 831—Río Napo, Ecuador; British Mus.

¹ Specimen in Zoolog. Mus., Berlin.

This well-marked species appears to have no very close allies. It ranges from Colombia to southeastern Perú without any perceptible differentiations. It appears to be restricted to the Upper Tropical Zone on the eastern side of the Andes.

A female from Idma, Urubamba Valley, dated October 19, is noted as breeding and other specimens, dated from September to November, are marked as with enlarged gonads.

Earlier Peruvian records are from Huayabamba, Amable Maria, Ninabamba, Cosñipata, Monterico, Huiro, and Huambo.

SPECIMENS EXAMINED

E. gigas.—

PERÚ:

- Inambari, 1 ♀;
- Río Távora, 1 ♀;
- Astillero, 1 ♂, 1 ♀;
- La Pampa, 1 ♂, 1 ♀;
- Idma, 1 ♀;
- Pozuzo, 2 ♂;
- Perené, 2 ♂, 1 ♀;
- La Merced, 1 ♂;
- mouth of Río Urubamba, 3 ♂;
- Santa Rosa, Río Ucayali, 1 ♂;
- Vista Alegre, 1 ♂¹;
- Río Colorado, 1 ♀¹.

ECUADOR:

- Zamora, 3 ♂;
- Archidona, 1 ♂;
- Andoas, 1 ♂;
- "Ecuador," 1 (?)

COLOMBIA:

- Villavicencio, 2 ♂;
- La Morelia, 1 ♀.

[*Elaenia pelzelni* Berlepsch

Elaenia pelzelni BERLEPSCH, 1907, Ornith., XIV, p. 397—Lamalunga, Río Negro, Brazil; Vienna Mus.

This species has not been found in Perú, so far as I know, but occurs so near to it that a statement of the occurrence may not be out of place in the present series of papers. A male and a female from the mouth of the Río Curaray, eastern Ecuador, demonstrate a broad westward extension of range north of the Amazon and it is highly probable that the species exists also in Peruvian territory at the mouth of the Napo.

¹ Specimens in Field Museum of Natural History, Chicago.

Pelzelni also occurs on both sides of the Río Madeira, as shown by numerous skins in the collection before me, representing the first recorded examples from the south bank of the Amazon.

A young male from Villa Bella Imperatriz differs from the adults by having two broad whitish wing-bars and a narrower third bar, a broad whitish stripe on the external margin of the inner tertial and extensive white toward the tips of the other tertials and at the tips of the secondaries and inner primaries, pale fulvous upper tail-coverts, and prominent white at the tip of the tail. The type of the species, said by Hellmayr to be immature, is described as having rufous wing-bars and fulvous under wing-coverts.

SPECIMENS EXAMINED

E. pelzelni.—

BRAZIL:

- Rio Negro, Igarapé Cacao Pereira, 3 ♂, 1 ♀;
- Faro, 3 ♂, 3 ♀;
- Monte Alegre, 1 ♂;
- Villa Bella Imperatriz, 3 ♂, 1 ♀;
- Rio Madeira, Igarapé Auará, 1 ♀;
- Rosario, 1 ♂, 2 ♀;
- Santo Antonio de Guajará, 2 ♂, 5 ♀, 1 (?)

ECUADOR:

- mouth of Río Curaray, 1 ♂, 1 ♀.]

Elaenia cristata Pelzelni

Elaenia cristata PELZELN, 1868, Orn. Bras., II, pp. 107, 177—City of Goiás, Brazil; Vienna Mus.

E(laenia) lophotes BERLEPSCH AND LEVERKÜHN, 1890, Ornith., VI, p. 13 (in text)—Merumé Mts., British Guiana; cotypes in Berlepsch Coll., Frankfurt Mus.

Elaenia cristata whitelyi CHUBB, 1919 (Oct.), Ann. Mag. Nat. Hist., (9) IV, p. 304—Mt. Roraima, "British Guiana" [= Venezuela]; British Mus.

There is a single record of *cristata* from Santa Ana, Urubamba Valley, which not only is unique for Perú but provides a locality far removed from the nearest point in the otherwise known range of the species. A male and a female from Primavera and Jurueña, respectively, in Matto Grosso, Brazil, are the most westerly specimens at hand from south of the Amazon although north of that stream the range includes Faro and the Guianas and extends west-

ward to Mt. Duida and, apparently, also in northern Venezuela at La Trilla.

The Peruvian bird, a male, is said to have the wing 78 mm. in length and the tail, 72, both measurements well above those of any of over a hundred specimens at hand from various parts of the range. However, Pinto (1936, Rev. Mus. Paulista, XX, p. 106) gives the measurements of some specimens from São Paulo that show correspondingly large size and it is not impossible that the Peruvian record is based on a migrant or straggler from near São Paulo. I am not sure, however, that this species migrates. Birds from different parts of the specific range show different seasonal conditions that do not fit into a picture of migrational movement. On the Orinoco where the bird breeds in April, specimens taken in April and May are badly worn, while from July to January there are varying degrees of freshness. On the other hand, specimens from southeastern Brazil are in fresh condition in March, April, and May. Dutch Guianan birds are molting in August; Faro specimens in December, lower Amazonian specimens in April as well as in August; Duidan skins in March.

There are puzzling variations discernible in the series of this species but I am unable to determine their significance. Perhaps the most striking differences are to be found in a few fresh skins from Piahy and others from Bahia (Morro de Chapau). The Piahy birds agree well with most of the examples from throughout the range of the species, being relatively lightly colored on the back, with rather clear whitish wing-bars, and with the dark feathers of the crest margined with grayish; the largest male has the wing 70.25 mm. and the tail, 60. The Morro de Chapau specimens are decidedly darker on the back, have the wing-bars slightly duller, and the black feathers of the crest unmargined; the wing is 74 to 75 mm. and the tail, 67. In comparison with the Piahy birds, the differences are pronounced. Nevertheless, certain individuals from various places show decided trends toward these dark Bahian birds while several "Bahia" trade-skins show little or no tendency in that direction. Chubb (*loc. cit.*) described certain dark

birds from Mt. Roraima and British Guiana as "*whitelyi*" and Wetmore (1939, Proc. U. S. Nat. Mus., LXXXVII, p. 233) has called attention to large, dark birds from northern Venezuela. The significance of these aberrant examples has yet to be determined. For the present, I am unable to discover sufficient regularity in the variation to warrant the recognition of more than one form of the species.

E. cristata differs from most of the other members of the genus by reason of its more linear nostril at the lower edge of the nasal operculum and by its wing-formula, with the outermost (tenth) primary very short, subequal to the second or third, and the ninth usually shorter than the sixth. *E. ruficeps* is very similar in these respects, going even farther in extreme cases away from the condition in most of the other *Elaenias*.

There is considerable resemblance between *cristata* and *ruficeps*, not only in the respects mentioned but also in general appearance. Some *cristata* have stronger indications of pectoral stripes than usual though far less than shown by *ruficeps*, and a few examples of *cristata* even show faint traces of a buffy cinnamomeous color on the tips of the occipital feathers in the region where *ruficeps* has its broad rufous patch. Possibly there is an ancient relationship hereby indicated. In any case I believe these two species should stand adjacent to each other as they were placed by Berlepsch. Both appear to be inhabitants of savanna, as recorded for *cristata* by Berlepsch and Hartert (1902, Novit. Zool., IX, p. 43) and as indicated for *ruficeps* on the label of the Faro specimen listed below.

SPECIMENS EXAMINED

E. cristata.—

BRAZIL:

- Goyaz, Rio Esperanza, 1 ♂;
- "Goyaz," 2 (?);
- "Bahia," 4 (?);
- Bahia, Morro de Chapau, 4 ♂;
- Primeira Cruz, 1 ♂;
- Piahy, Theresina, 2 ♂, 1 ♀, 1 (?);
- Matto Grosso, Primavera, 1 ♂;
- Juruena, 1 ♀;
- Rio Tapajoz, Santarem, 2 ♂, 3 ♀, 1 (?);
- Igarapé Brabo, 1 ♀;
- Rio Jamundá, Faro, 1 ♂, 3 ♀;

Monte Alegre, 1 ♂.

FRENCH GUIANA:

Cayenne, 3 ♂, 3 ♀.

DUTCH GUIANA:

near Paramaribo, 1 ♂, 2 (?)

BRITISH GUIANA:

Annai, 1 ♀;

"Guiana," 1 ♂.

VENEZUELA:

Roraima, 2 ♂;

Mt. Duida, Valle de los Monos, 1 ♂, 4 ♀;

Esmeralda, 11 ♂, 15 ♀;

Río Orinoco, Altagracia, 3 ♂, 1 ♀, 1 (?)

Agua Salada de Ciudad Bolívar, 1 ♂;

Ciudad Bolívar, 1 ♂, 1 ♀;

Maripa, 2 ♂, 1 ♀;

Caicara, 1 ♂;

Quiribana de Caicara, 1 ♀.

E. ruficeps.—

BRAZIL:

Faro, 1 ♀;

Rio Negro, Yavanari, 1 ♀.

VENEZUELA:

Río Huaynia, junction of the Cassiquiare,
5 ♂, 1 ♀;

Río Cassiquiare, Buena Vista, 1 ♂;

Mt. Duida, Valle de los Monos, 2 ♀;

Savana Grande, 1 ♀.

Elaenia chiriquensis albivertex Pelzel

Elaenia albivertex PELZELN, 1868, Orn. Bras., II, pp. 107, 177—Ypanema, São Paulo, Brazil; Vienna Mus.

Elaenia lundii REINHARDT, 1870, Vidensk. Medd. naturhist. Foren., p. 344, Pl. VIII, fig. 1—Lagôa Santa, Minas Gerais, Brazil; Copenhagen Mus.

Elaenia gracilis TACZANOWSKI, 1884, Orn. Pérou, II, p. 271—Chirimoto, Perú; Warsaw Mus.

Elaenia sororia BANGS, 1898, Proc. Biol. Soc. Wash., XII, p. 175—Palomina, Santa Marta, Colombia; Mus. Comp. Zool.

Lomo Santo, 2 ♂; Perené, 2 ♂; Tulumayo, 1 ♀.

I can find no clear distinctions in a series of over two hundred and forty specimens from different parts of South America (excluding northwestern Ecuador and southwestern Colombia = *brachyptera*). The form breeds at Ciudad Bolívar, on the Orinoco, in April and at Belvedere de Urucum, Matto Grosso, in December and there is corresponding difference in conditions of molt at various places throughout the range.

Earlier records from Perú are from Chirimoto, Potrero, Chachapoyas, and Vista Alegre.

Elaenia obscura obscura (D'Orbigny and Lafresnaye)

Muscipela obscura D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, Cl. 2, "Syn. Av.," p. 48—Yungas, Bolivia; Paris Mus.

Muscipela Guillemini D'ORBIGNY, 1839, Voy. Amer. Mérid., Ois., p. 319—new name for *Muscipela obscura* D'Orbigny and Lafresnaye.

Muscicapa rustica CABANIS AND HEINE, 1859, Mus. Hein., II, p. 60, in text, in synonymy of *E. obscura*.

Elaenia frantzii stolzmanni RIDGWAY, 1906 (Sept. 6), Proc. Biol. Soc. Wash., XIX, p. 116—Tambillo, Perú; ♀; U. S. Nat. Mus.

Elaenia obscura tambillana BERLEPSCH, 1907 (Febr.), Ornith., XIV, p. 419—Tambillo, Perú; ♀; Frankfurt Mus.

Peruvian birds appear to be inseparable from Bolivian specimens. There is some variation in the exact tone of coloration and in the amount of grayish suffusion of certain parts of the plumage but the upper surface is always definitely brownish in color rather than grayish olive, the distinguishing feature of Brazilian specimens as detailed in the description of the new form given below.

I have not seen the types of *stolzmanni* and *tambillana* but believe that both names were erected for the female sex of *obscura*. The supposed form, which would be entitled to the name *stolzmanni*, is said to be smaller than *obscura*, darker and browner on the upper surface and brighter yellow beneath, particularly on the throat. In the series of *obscura* now at hand, four of the birds are sexed as females and these four, two from Bolivia, one from central Perú and one from northern Perú, are smaller than the males, are brighter yellow below, particularly on the throat, and average darker brown above. Their measurements are equal to, or less than, those given for the two Tambillo specimens. The same relative characters appear, though less pronouncedly, in a longer series of Brazilian specimens belonging to the subspecies described below. One exception in the Peruvian series is a worn example, not fully adult, from Chachapoyas, sexed as a male but agreeing better with the females in regard to size and color. I consider *stolzmanni* as a pure synonym of *obscura*.

Although there are various points of re-

semblance between *obscura* and *frantzii*, I am not convinced that they belong in the same species and prefer to restrict *obscura* to the two forms discussed here. There is an appreciable gap between the ranges of the two species and no close approximation of coloration though there is of size. The pronounced pale area on the basal part of the inner webs of the tertials and the very broad pale stripe on the outer web of the innermost tertial are good diagnostic characters. In addition, *obscura* is much more deeply yellow beneath and the dusky spot before the eye is more pronounced. I consider *E. d. dayi* and *E. dayi tyleri* to be more closely related to *obscura* than is *frantzii* although the differences are, presumably, of specific value. Dr. Chapman (1929, Amer. Mus. Novitates, No. 341, p. 3) noted the resemblance of *dayi* to *obscura* when he described that Roraiman species.

Records of *obscura* from Perú are from Huíro, San Miguel Bridge, Paltaypampa (Jelski), Pumamarca, Ninabamba, Garita del Sol, Eneñas, Huacapistana, Tamborapa, and Chira.

Elaenia obscura sordida, new subspecies

TYPE from Franca, São Paulo, Brazil. No. 140,088, American Museum of Natural History. Adult female collected in September, 1910, by Garbe; original No. 26.

DIAGNOSIS.—Differs from *E. o. obscura* of northern Bolivia and Perú by darker, duller, and more olivaceous, less brownish, upper parts, with less contrast between the back and the head, and by darker, more grayish-tinged breast, throat, and flanks; wing and tail averaging longer.

RANGE.—Southern Brazil, from Minas Gerais south to Rio Grande do Sul and west to southern Matto Grosso, and eastern Paraguay.

DESCRIPTION OF TYPE.—Upper parts Deep Olive X Deep Grayish Olive, the top of the head a little darker; a dull olive yellowish superciliary stripe and a narrow subocular lunule of the same color; a dusky spot on lores immediately in front of the eye; auriculars largely like back but their bases and the malar region paler. Throat Grayish Olive, paler in the middle and with chin more grayish; breast Grayish Olive with a more grayish wash, strongest on the sides and continued broadly down the flanks; lower belly Reed Yellow, this color narrowing and weakening anteriorly until it is lost in the color of the breast; under tail-coverts with broad centers olive gray margined with dull, pale yellow. Wings blackish brown with the primaries and secondaries narrowly margined exteriorly with Olive-Buff except

at the distal ends of the primaries and the basal ends of the secondaries; tertials and inner secondaries with the margins broader and paler, the inner tertial with broad marginal stripe yellowish white; lesser upper wing-coverts like the back; median and greater series dusky brown with broad tips Pale Olive-Buff forming two conspicuous wing-bars, crossing both webs of the median series but largely restricted to the tips of the outer webs of the greater series; under wing-coverts Marguerite Yellow; inner margins of remiges Ivory Yellow. Tail blackish brown with exterior margins of rectrices olivaceous and with narrow, poorly defined pale tips. Bill (in dried skin) blackish brown, yellowish brown at base of mandible; feet dark brown. Wing, 86.25 mm.; tail, 81; exposed culmen, 11; culmen from base, 16; tarsus, 21.

REMARKS.—Males like the females but larger and averaging darker and duller; wing, 87–96 mm.; tail, 79–91 as compared with: females, wing, 81.5–89; tail, 75–82. In typical *obscura*: males, wing, 82.5–89; tail, 77.5–85.5; females, wing, 79–82; tail, 75.5–77.

There is considerable individual variation in the series of Brazilian birds, many of which are decidedly darker than the specimen I have taken for the type, reaching an extreme near Dark Olive. The appearance of the upper side is always a grayish olive in contrast to the definitely warmer and browner upper surface in *obscura*. Some examples of *obscura* have a grayish tinge on the breast and sides but, when compared with the same region in *sordida*, it has a browner tone.

There is occasional distinction in the width of the marginal stripe on the tertials in the two forms. In *obscura*, the white stripe on the inner tertial sometimes exceeds half the width of the outer web, rarely touching the shaft, while in *sordida* it appears always to be less than half the width of the outer web. This is not, however, constant since some *obscura* also have the stripe narrow.

Berlepsch and Ihering (1885, Zeitschr. Ges. Ornith., III, p. 132) noted the distinguishing characters of Brazilian birds in comparison with Bolivian and Peruvian specimens. They resurrected the name *rustica* for this form in the belief that this name had not been properly published theretofore and was available for subsequent use. Unfortunately the first pub-

lished usage of *rustica* was by Cabanis and Heine in the "Museum Heineanum," II, p. 60, 1859, where it appears in the synonymy of *Elaenia obscura* and, being without accompanying description, is identifiable only by the original descriptions of Tschudi and of D'Orbigny and Lafresnaye to which reference is made. Thus, *rustica* must be relegated to the synonymy of *obscura*. A second usage of *rustica* by Sclater, 1861, P. Z. S. London, p. 408, is likewise validated by a reference to Tschudi which is here placed subordinate to *rustica*. Consequently *rustica* is not available for the Brazilian birds.

Incidentally, Allen, 1889, Bull. Amer. Mus. Nat. Hist., II, No. 3, p. 206, discounted the findings of Berlepsch and Ihering because of an overlap in measurements and a belief that supposed differences of color might have been due to season. The material at hand, however, shows the differences to be present as indicated regardless of season.

Birds from the Tucumán region of Argentina are intermediate though they are browner above than most *sordida*. One female from near San Pablo is abnormally grayish but has more of a brownish than olivaceous tinge. Also in measurement Tucumán birds are intermediate although one male from near San Pablo has the tail as long as any *sordida*. The Argentine birds may be referred to *obscura* as the form to which they show the nearest approach.

SPECIMENS EXAMINED

E. o. obscura.—

PERÚ:

- Tulumayo, 2 ♂, 1 ♀;
- Chilpes, 1 ♂;
- Chinchao, 1 ♂¹;
- Molinopampa, 1 ♂¹;
- Chachapoyas, 1 ♂, 1 "♂" [= ♀?], 1 ♀.

BOLIVIA:

- Incachaca, 1 ♂, 1 ♀;
- Camp Woods, Prov. Sara, 1 ♀.

ARGENTINA²:

- Tafi Viejo, 1 ♂;
- near San Pablo, 3 ♂, 3 ♀.

E. o. sordida.—

BRAZIL:

- Branca Catharina, Poço Prieto, 1 [♀];

- Rio Grande do Sul, Quinta, 1 [♂], 2 (?);
- Taquará de Mundo, 1 ♀;
- Hamburgo Velha, 2 ♂, 1 ♀;
- Santa Cruz, 1 ♀;
- Campo Bom, 2 ♂;
- Sapyringa, 3 ♂, 2 ♀;
- Lagôa dos Patos, 4 ♂;
- São Paulo, Itararé, 1 ♂;
- Victoria, 2 ♂, 2 ♀;
- Franca, 1 ♀ (type);
- Rio de Janeiro, Monte Serrat, 1 ♂, 1 ♀;
- Minas Geraes, Varzea de Congonha, 1 ♀;
- Casa Queimada, 1 ♂, 1 ♀;
- Matto Grosso, Campanario, 1 ♂, 2 ♀.

PARAGUAY:

- east of Caaguasú, 1 ♂;
- east of Yhú, 1 ♂.

Elaenia pallatangae intensa, new subspecies

TYPE from San Pedro, south of Chachapoyas, Perú; altitude 8600-9400 feet. No. 235,568, American Museum of Natural History. Adult male (with greatly enlarged gonads) collected January 22, 1926, by Harry Watkins; original No. 10,001.

DIAGNOSIS.—Similar to *E. p. pallatangae* of Ecuador and Colombia but with yellow of under parts much more intense; top of head averaging nearer the color of the back, less contrastingly dark.

RANGE.—Subtropical Zone of Perú.

DESCRIPTION OF TYPE.—Upper parts a little browner than Olive; the top of the head with darker centers on crown and occiput, concealed by the overlying tips of the feathers; center of crown and occiput with a moderately large, concealed area of white, slightly tinged with brown adjacent to the Olive tips. Lores brownish, paler than the top of the head; a rather broad eye-ring of dull yellowish, interrupted at the anterior corner of the orbit; auriculars brown, tinged with yellowish at the bases of the feathers; chin dull grayish, tinged with yellow; throat more strongly yellowish; sides of breast much like the back, with the color tending to spread across the breast in a lighter tone, approaching Citrine Drab with some yellower flammulations; belly broadly rich Barium Yellow × Straw Yellow; flanks with darker (brownish) centers showing through the yellow tips; thighs light olive brownish; under tail-coverts like belly. Wings blackish brown; primaries, except outermost, and the distal portion of the other remiges with narrow outer margins pale, dull olivaceous; secondaries with outer margins more broadly dull Reed Yellow except toward the base where there is a squarish patch of dark brown; inner tertial with most of outer web Ivory Yellow and with the basal part of inner web broadly buffy; other tertials with a narrow marginal stripe Ivory Yellow, obsolete basally but broadening distally and rounding the tip of the feather; tips of secondaries with similar pale border and primaries with a fine pale terminal speck, nearly

¹ Specimens in Field Museum of Natural History, Chicago.

² Not typical.

obsolete; upper wing-coverts like back; median and greater series blackish brown with broad tips Ivory Yellow, forming two conspicuous wing-bars; under wing-coverts Naphthalene Yellow; inner margins of remiges dull Ivory Yellow. Tail blackish brown with Ivory Yellow terminal margins and with outer margins of all but external pair of rectrices Olive; external pair with outer web paler than the inner web though not conspicuously so. Bill (in dried skin) dark brown, maxilla more blackish; feet blackish brown. Wing, 77.5 mm.; tail, 68; exposed culmen, 10; culmen from base, 11.5; tarsus, 18.2.

REMARKS.—Females like the males but averaging slightly smaller. Wing, 70–75.25 as against 72.5–79; tail, 60–67 as against 63–69.

In worn plumage the wing-markings fade to white, the pale tips of the remiges and rectrices may wear off, the pale outer web of the outer rectrices becomes more conspicuous, the dark centers of the crown-feathers become more evident, and the yellow of the under parts fades perceptibly, but the distinctions from *pallatangae* are still present in comparison with specimens of the typical form in similar condition of plumage. Even the freshest skins of *pallatangae*, though the yellow of their under parts may be as strong as in the more faded *intensa*, and this is not always the case, have this yellow on the more greenish side of the spectrum, not tinged with Straw Yellow.

Some specimens of *pallatangae* are decidedly grayish olive on the chest and sides; *intensa* tends rather to brownish in this region as do some *pallatangae*.

One or two examples of *pallatangae* are as dark above as *olivina* of Mt. Roraima and Mt. Duida though with less of the greenish tinge of that form above and beneath. *Olivina* also has the bill averaging longer and the wing-bars averaging narrower but these characters are overcome by the individual variation of both forms. I see no reason to keep *olivina* specifically distinct from the *pallatangae* group where I place it.

Peruvian records presumably referable to *intensa* are from Paltaypampa, Churay, Tambopata, Pariayacu, Maraynioc, Tamia-pampa, Cutervo, Chota, Tambillo, Huachipa, Chinchao, mountains near Huán-

uco, mountains near Panao, and near Molinopampa.

SPECIMENS EXAMINED

E. p. pallatangae.—

COLOMBIA:

Cerro Munchique, 1 ♂, 3 ♀;
La Florida, 1 ♂;
San Augustin, 1 ♀;
La Sierra, 2 ♂;
Mari Lopez, 1 ♀.

ECUADOR:

San Bartolo, 1 ♂;
Zamora, 1 ♂, 1 (?);
Sabanilla, 3 ♂;
"Quito," 2 (?).

E. p. intensa.—

PERU:

San Pedro, 1 ♂ (type), 1 ♀;
Chachapoyas, 1 ♂;
La Lejia, 2 ♂, 3 ♀;
Chilpes, 1 ♂, 3 ♀;
Rumicruz, 3 ♂, 3 ♀;
Torontoy, 1 ♂;
Marcapata, 1 ♂;
Limbaní, 1 [♂].

E. p. olivina.—

VENEZUELA:

Mt. Roraima, Arabupu, 1 ♀;
Philipp Camp, 1 ♂, 1 ♀;
"Roraima," 2 ♂, 1 (?);
Mt. Duida, Laterite Valley, 1 ♂;
El Puente, 1 ♀;
"Primer Pico," 1 ♂, 1 ♀.

Mysiopagis gaimardii gaimardii (D'Orbigny)

Muscicapara Gaimardii D'ORBIGNY, 1839, Voy. Amér. Mérid., Ois., p. 326—Yuracares, Bolivia; Paris Mus. and Mus. Comp. Zool.

The typical form of the present species is characterized by moderately clear olive-green back, neither so light as that of *bogotensis* nor as dark as in *guianensis*; Barium Yellow or Citron Yellow belly; breast with relatively strong yellow margins on the feathers in some contrast to the dark centers that may be present; throat with at least the lower portion tinged with yellow, sometimes the whole throat.

Two males from Mission San Antonio, Cochabamba, Bolivia, are unusually dull on the belly in comparison with a female from Todos Santos, while a male from Porto Velho, Rio Madeira, has the breast unusually olivaceous. A male from Pomará, northern Perú, has the throat more strongly yellow than any of the others in the series and a male from Rio Negro, west

of Moyobamba, has the back darker green than the others; the Todos Santos female has the lightest back. There is thus considerable variation within the series represented by this range of localities, including one bird from Zamora, Ecuador, but it is impossible to segregate any parts of the series as representing different subspecies. For the present, therefore, I am obliged to consider typical *gaimardii* as being a rather variable form.

On the other hand, two specimens from Puerto Indiana, on the north bank of the Amazon at the mouth of the Río Napo, and a few specimens from Teffé and the left bank of the Rio Madeira, Brazil, are distinctly darker on the back and more strongly striped on the chest than even the Río Negro (Perú) example, agreeing better with Guianan specimens. They are discussed further under *guianensis*.

Records from Perú that belong with *gaimardii* are from Yahuar mayo, Rioja, and Moyobamba.

***Myiopagis gaimardii guianensis* (Berlepsch)**

Elaenia gaimardii guianensis BERLEPSCH, 1907, Ornith., XIV, p. 421—Camacusa, British Guiana; ♂; Berlepsch Coll., Frankfurt Mus.

Birds of this species from the three Guianas are darker on the upper surface than specimens from central and southern Perú and Bolivia, sometimes with exposed dark subterminal areas on the mantle feathers, and sometimes simply a darker olive. Even single specimens usually can be separated by this criterion while in series the distinction is quite apparent. Furthermore, the Guianan birds tend to have a little more pronounced dark centers on the pectoral feathering though this is too variable to be of any great service taxonomically. Both groups have the belly rather deeply yellow.

Using these characters as a basis for distinction, it appears that the specimens at hand from the Orinoco, Mt. Duida, the Cassiquiare, and the Río Negro (Brazil) agree much better with the Guianan series than with true *gaimardii*. As noted under *gaimardii*, a small series from the upper Amazon, including the left bank of the

lower Madeira, Teffé, and the mouth of the Napo, fits well into the same group, especially the Teffé and lower Napo birds which are as dark as any in the assemblage. These birds may well be separated as *guianensis*.

Contrary to expectation, specimens from Faro are not in agreement with Cayenne birds or Río Negro specimens but are more like a long series of skins from the south bank of the lower Amazon, representing a form that has not heretofore been recognized. It is described below.

Judging by the lower Napo specimens, the record of *gaimardii* from Pebas should belong rather with *guianensis*.

Before leaving the discussion of *guianensis*, it will be well to mention a female from Mt. Roraima, 3500 feet elevation, collected by Whitely. This bird agrees with *guianensis* in coloration but is very large, with wing 66.75 mm. in length; tail, 58.5. The wing exceeds slightly the maximum I have for any form of the species and the tail is just under the maximum of *trinitatis*. Since *trinitatis* differs from *guianensis* only in size, this Roraiman specimen is indistinguishable from *trinitatis* but this association is not very probable. The skin agrees with Whitely's Guianan specimens in "make" and there is no evidence that it is erroneously labeled. Consequently I am unable to give a name to the specimen. Other Roraiman birds should be reexamined.

***Myiopagis gaimardii subcinereus*, new subspecies**

TYPE from Prata, near Pará, Brazil; altitude 45 meters. No. 499,546, American Museum of Natural History. Adult male collected December 2, 1905, by W. Hoffmanns; original No. 243.

DIAGNOSIS.—Similar to *M. g. gaimardii* of northern Bolivia and eastern Perú but with back duller greenish (sometimes tinged with brownish on mantle); throat usually clearer whitish; belly paler yellow; breast more predominantly ashy grayish, with less obvious yellow margins on the feathers. Differs from *M. gaimardii guianensis* of the Guianas, southern Venezuela, Río Negro, Brazil, and other parts of its range by similar characters and with the mantle usually lighter as well as grayer olive.

RANGE.—Lower Amazonian region of Brazil; most typically from the region around Pará, Maranhão, and northern Goyas; less typically

along the south bank of the Amazon westward to the right bank of the Rio Madeira and southward to northern Matto Grosso, and on the north bank of the Amazon near Fato.

DESCRIPTION OF TYPE.—Top of head Iron Gray with a large, imperfectly concealed patch of white in the center of the crown and occiput; hind neck lighter gray; mantle Citrine Drab; uropygium dull Light Yellowish Olive. Lores, superciliary stripe, and malar region whitish; auriculars light brownish with shafts pale at base; throat broadly whitish; breast light ashy gray with poorly developed yellowish margins on the feathers, not well defined; belly light Reed Yellow with grayish centers on the feathers of the upper abdomen and, less prominently, on the flanks; under tail-coverts yellow. Wings dusky brown; primaries with poorly defined, narrow, olivaceous margins; secondaries with distal part of outer margins more broadly Reed Yellow, leaving a dusky patch just beyond the tips of the greater wing-coverts; tertials with outer margins distinct, whitish on the innermost; lesser upper wing-coverts like the back; median series tipped and greater series externally margined with Marguerite Yellow, forming two conspicuous wing-bars; under wing-coverts largely Primrose Yellow but under primary-coverts paler and with exposed brownish centers; inner margins of remiges pale yellow. Tail lighter brown than the wings, with olive outer margins on the rectrices. Bill and feet (in dried skin) blackish brown. Wing, 58 mm.; tail, 55.5; exposed culmen, 9; culmen from base, 12.25; tarsus, 17.

REMARKS.—Female like the male in color but with shorter wing and proportionately still shorter tail. Wing, 54.25–59 mm. (males, 57–62.25); tail, 46–50 (males, 52–57).

The back in numerous examples of this form is as dark as in the lighter specimens of *guianensis*, sometimes similarly tinged with brownish, but apparently never as dark as in the more heavily marked Guianan birds. Occasional specimens, also, have the yellow margins of the feathers of the breast more strongly developed, presenting a more streaked appearance than usual, but the gray centers remain paler and more ashy than in *gaimardii* and *guianensis*. *Subcinereus*, therefore, is not an intermediate between the two adjacent forms mentioned but reaches a new extreme. Single specimens may prove troublesome to identify but in series the characters stand out reasonably well. With the recognition of this new form it is easier to assign a name to the lower Amazonian

birds than was possible with the necessity of calling them either *gaimardii* or *guianensis*.

As in related forms, certain individuals have the white area of the top of the head noticeably tinged with pale yellow, a purely individual character.

Birds from northern Matto Grosso (Chapada and Tapirapoan) agree fairly well with the Borba examples of *subcinereus* and are better referred to this subspecies than to typical *gaimardii*. Pelzeln's name *elegans* (1868, Orn. Bras., II, pp. 107, 179—Engenho do Gama, Brazil) is unfortunately preoccupied by *Muscicapa elegans* D'Orbigny and Lafresnaye, 1837 = *Myiopagis viridicata* (Vieillot) or it might otherwise be available for the present form.

I adopt the generic name *Myiopagis* for the species *gaimardii*, *viridicata*, *cotta*, *flavivertex*, *subplacens*, and *caniceps* which I consider congeneric though generically distinct from *Elaenia*. *Elainopsis* Ridgway I take to be a synonym. The tarsal envelope is far from typically exaspidean as claimed by Ridgway (1907, Bull. U. S. Nat. Mus., L, pt. 4, p. 399). Although some of the scutes may just pass around the hinder edge of the tarsus, in most cases they either just reach the hinder margin or fail to reach even that far, leaving a space of skin that may be smooth or may even show reticulation. In *gaimardii*, this condition is so constant that in erecting the genus *Elainopsis* for this species, Ridgway placed it among the Cotingidae. I prefer to consider the genus as Tyrannine with a strong tendency toward the Cotingidae, its final position to be determined only by careful anatomical investigation.

SPECIMENS EXAMINED

M. g. gaimardii.—

BOLIVIA:

Mission San Antonio, 2 ♂;
Tres Arroyos, 1 ♂;
Todos Santos, 1 ♀.

BRAZIL:

Rio Madeira, Porto Velho, 2 ♂.

PERÚ:

Rio Tavera, 1 ♂;
Prov. Junín, 1 (♀?);
Pomará, 1 ♂, 1 ♀;
Rio Negro, west of Moyobamba, 1 ♂.

ECUADOR:

Zamora, 1 ♀.

M. g. guianensis.—

PERÚ:

Puerto Indiana, 2 ♀.

BRAZIL:

Teffé, 1 ♂;

Rio Madeira, Rosarinho, 1 ♂, 3 ♀, 1 (?) ;

Santo Antonio de Guajará, 1 ♂;

Rio Negro, Manaus, 1 ♂;

Tabocal, 1 ♀;

Santa Isabel, 1 (?) ;

Yucabí, 1 ♂, 2 ♀, 1 (?) ;

Tatú, 2 ♂, 1 (?) ;

Rio Uaupés, Tahuapunto, 1 ♀;

Ilanete, 1 ♂.

VENEZUELA:

Rio Cassiquiare, Solano, 2 ♂, 1 ♀;

El Meroy, 1 ♀;

opposite mouth of Río Ocamo, 1 ♂;

Mt. Duida, Esmeralda, 1 ♀;

"Píe del Cerro," 1 ♂;

Río Orinoco, Ayacucho, 1 ♂;

Lalaja, 2 ♀;

Nericagua, 1 ♂;

Maripa, 2 ♂;

Caicara, 1 ♀;

Altigracia, 1 ♂;

Suapure, 4 ♂, 2 ♀;

Maipures, 4 ♂, 2 ♀;

Mato River, 2 ♂;

Río San Feliz, La Cascabel, 1 ♂;

Río Caura, La Unión, 2 ♂.

BRITISH GUIANA:

Bartica Grove, 1 (?) ;

Quonga, 2 ♀;

Rockstone, 2 ♂;

Wismar, 1 ♂;

Mines district, 1 (?) .

DUTCH GUIANA:

Lelydorp, 1 ♂;

Wanica, 1 ♂;

near Paramaribo, 1 ♂, 2 ♀.

FRENCH GUIANA:

Cayenne, 5 ♂, 3 ♀.

M. g. subsp.—

VENEZUELA:

Roraima, 1 ♀.

M. g. subcinereus.—

BRAZIL:

Pará, Prata, 1 ♂ (type), 1 ♀;

Quati-purú, 1 ♀;

Goyaz, Fazenda Esperança, 1 (?) ;

Rio Thesouras, 1 (?) ;

Maranhão, As Mangueiras, 1 ♂;

Rio Tocantins, Mocajuba, 2 ♂, 1 ♀;

Baião, 2 ♂, 2 ♀, 1 (?) , 1 "♂" [= ♀] ;

Cametá, 2 ♂;

Rio Xingú, Tapará, 2 ♂, 1 ♀;

Porto de Moz, 3 ♀;

Rio Tapajoz, Tauary, 3 ♂, 2 ♀;

Igarapé Brabo, 3 ♂, 4 ♀, 1 (?) ;

Aramanay, 2 ♂, 2 ♀;

Caxiricatuba, 1 (?) ;

Boim, 1 ♂;

Igarapé Amorin, 2 ♂, 1 (?) ;

Rio Amazonas, Villa Bella Imperatriz, 2 ♂;

Rio Madeira, Borba, 2 ♂, 2 ♀;

Matto Grosso, Chapada, 2 ♂, 1 ♀;

Uturity, 1 ♀;

Rio Jamundá, Faro, 5 ♂, 3 ♀.

M. g. bogotensis.—

COLOMBIA:

"Bogotá," 6 (?) ;

Santa Marta, Bonda, 3 ♂, 3 ♀, 9 (?) .

VENEZUELA:

Cumaná, Los Palmales, 1 ♂;

Campos Alegre Valley, 1 ♂, 1 ♀;

Quebrada Secca, 2 ♀;

Carabobo, Las Trincheras, 1 ♂, 2 ♀;

Bermúdez, Cumanacoa, 1 (?) ;

Sucre, Cristóbal Colón, 2 ♂, 1 ♀;

"Venezuela," 1 (?) .

M. g. trinitatis.—

TRINIDAD:

(various localities), 18 ♂, 5 ♀, 1 "♀" [= ♂] .

M. g. maculiventris.—

COLOMBIA:

Carthagená, 1 (?) (type).

PANAMÁ:

Boca del Cupe, 1 ♂;

Cape Garachiné, 1 ♂.

Myiopagis flavivertex (Sclater)

Elainea flavivertex SCLATER, 1887, P. Z. S. London, p. 49—"Upper Ucayali" [= near Cashiboya], Perú; British Mus.

I can do very little with regard to the present species except to add a few localities to the known distribution. There is appreciable variation in the intensity of coloration throughout the range but I am unable to find any taxonomic value in it. Females, beside being smaller than the males, average somewhat more brightly colored, often with less blackish on the sides of the crown, though some examples are indistinguishable in color. A male from the Rio Xingú is the darkest above and duller below of the series at hand and, in addition, is the largest bird in the series (wing, 63 mm.; tail, 59.5) though Hellmayr records a single specimen with still longer wing.

Young birds differ considerably from adults in certain particulars. I have no specimen in full juvenal plumage but four examples have much of the juvenal plumage still in place. These specimens show the upper wing-coverts to be cinnamon-drab (much as in young *M. viridicata*), the top of the head and back of the neck the same (lighter in tone than in *viridicata*),

and probably the rest of the upper parts the same color although only one specimen has any considerable part of the lower back not already changed to green. Sides of the head without the whitish eye-ring of *viridicatus* which is present even in the young of that species. The under parts are much like those of the duller adults although there is a cinnamon-drab tinge on the sides of the breast. One young female from Lalaja, near Mt. Duida, Venezuela, has lost most of the juvenal plumage and the newly acquired feathers are unusually brightly colored, exceeding those of any adult.

Peruvian records of *flavivertex* are from Nauta, Elvira, and the Ucayali.

The species has a very interrupted distribution so far as is known. Possibly future field work may help to close some of the more extensive gaps but at present the records show four principal populations, as may be seen by the accompanying list of specimens examined.

SPECIMENS EXAMINED

M. flavivertex.—

PERU:

- Sarayacu, 2 ♂, 1 ♀;
- Lagarto, 1 ♀;
- mouth of Río Urubamba, 1 ♂;
- Orosa, 1 ♂;
- Puerto Indiana, 1 ♂;
- Anayacu, 1 ♀.

BRAZIL:

- Tefé, 1 ♂;
- Rio Madeira, Rosarinho, 1 ♂;
- Borba, 1 ♂;
- Igarapé Auará, 3 ♂, 3 ♀, 2 (?);
- Rio Amazonas, Villa Bella Imperatriz, 2 ♂;
- Rio Xingú, 1 ♂;
- Rio Jamundá, Faro, 3 ♂, 2 ♀, 1 (?).

FRENCH GUIANA:

- Roche Marie, 1 ♂.

GUAYANA:

- Interior, 3 ♂, 1 ♀;
- Ryweg, 1 ♂;
- Kwata, 1 (?);
- near Paramaribo, 1 ♂, 1 (?).

VENEZUELA:

- Río Orinoco, Munduapo, 2 ♂, 2 ♀;
- Lalaja, 1 ♂, 1 ♀;
- Mt. Duida, Caño León, 1 ♂.

Myiopagis viridicatus viridicatus Vieillot

Sylvia viridicatus VIEILLOT, 1817, Nouv. Dict. Hist. Nat., nouv. éd., XI, p. 171—based on Azara, No. 156; Paraguay.

M. (uscicapa) elegans D'ORBIGNY AND LAFRES-

NAYE (nec Lesson, 1830), 1837, Mag. Zool., VII, cl. 2. "Syn. Av.," p. 52—Chiquitos, Bolivia.

Elatina grata CABANIS, 1883, Jour. fur Orn., XXXI, p. 216—Biscacheral, Tucumán, Argentina; Berlin Mus.

Elatina viridicatus delicatus BERLEPSCH, 1907, Ornith., XIV, p. 430—part; type from Bahia, Brazil (trade-skin); Frankfurt Mus.

Myiopagis viridicatus rondoni CHERRIE, 1916, Bull. Amer. Mus. Nat. Hist., XXXV, p. 188—Urucum, Matto Grosso, Brazil: ♂; Amer. Mus. Nat. Hist.

Idma, 1 ♂.

In a series of sixty birds from various parts of southern Brazil, Paraguay, Argentina, and Bolivia, including also the Peruvian skin listed above, I cannot satisfactorily distinguish any geographical subspecies. Differences exist that are not easily explained except on the basis of individual variations. In any case, there are available names in the synonymy listed above to supply any possible need that is suggested in the present series.

Earlier Peruvian records are from Maranura and Santa Ana, only a few miles from Idma.

In the comparative material examined in this connection, are seventy-six specimens representing *accola* and *pallens*. By far the largest part of this series shows no appreciable distinctions. Ten examples from various localities in Nicaragua are intermediate with *placens* but the Costa Rican, Panamanian, and Colombian specimens, with the possible exception of three Santa Marta birds, cannot satisfactorily be subdivided and should stand together as *accola*. The Santa Marta birds are slightly paler on the upper side and have the throat less purely white and the chest less strongly shaded with olive or grayish than the other birds mentioned. It is possible, therefore, to recognize *pallens* if its Colombian range is restricted to the Santa Marta region but not otherwise.

Five birds from Caicara and Quiribana de Caicara, in the Orinoco region of Venezuela, agree fairly well with the Santa Marta skins but have the margins of the greater and median upper wing-coverts finely and rather sharply outlined with pale yellowish green. They also have the bill a little smaller than in the Santa Marta birds, agreeing better, in this respect, with typical

viridicata and have the yellow of the crest slightly more strongly tinged with chrome. It is possible that they represent an unnamed form but may go with *pallens* for the present. A young bird from San Estéban, inland from Puerto Cabello, presumably belongs here also.

"*Elaenia viridicata huallagae*" Carriker, 1934, Proc. Acad. Nat. Sci. Phila., LXXXVIII, p. 326, is *Neopelma sulphureiventer*, of the family Pipridae. The type, kindly lent to me by Mr. de Schauensee and Mr. Bond of the Academy, has the yellow of the under parts a very little brighter than is shown by a series of Bolivian specimens and has a little less dark shading on the chest, somewhat more broadly margined with yellowish. However, the type of *sulphureiventer*, from Matto Grosso, Brazil, is described as having the whole under parts pale yellowish, apparently more like the Peruvian specimen than the Bolivian.

Carriker's record establishes the occurrence of *Neopelma sulphureiventer* in Perú since there are no earlier known examples from this country.

Myiopagis subplacens (Selater)

Elainea subplacens SCLATER, 1861, P. Z. S. London, p. 407—Pallatanga, Río Chimbo, Ecuador; ♂♂ cotypes in Brit. Mus.

Milagros, 1 ♂, 1 ♀; Paletillas, 4 ♂, 3 ♀; Palambla, 1 ♂, 6 ♀.

There is no apparent difference between Peruvian and Ecuadorian birds, and little variation throughout a series of forty-three specimens from both countries. A female from Esmeraldas, Ecuador, is distinctly paler than the remainder of the series, with lighter and clearer greenish back, lighter sides of the crown, paler gray chest, and

broader wing-bars. A bird from the same locality, without given sex, is little different from the average and more material from this northernmost part of the specific range will be necessary to determine any constancy in the characters noted.

There are Peruvian records from Lechugal. One from Paucal (Raimondi Collection) needs confirmation. Taczanowski's record from the "Upper Ucayali" is certainly erroneous though it is difficult to say where the record should go.

Myiopagis caniceps cinerea (Pelzeln)

Elainea cinerea PELZELN, 1868, Orn. Bras., II, pp. 108, 180—Marabitanas, Rio Negro, Brazil; ♂; Vienna Mus.

Serpophaga albogrisea SCLATER AND SALVIN, 1880, P. Z. S. London, p. 156—Sarayacu, Ecuador; British Mus.

Apayacu (Anayacu), 1 ♂, 1 ♀.

Apparently rather rare in Perú and not very abundant anywhere, judging by the number of specimens at hand or recorded. Other Peruvian records are only from Puerto Bermúdez and Chamicuros.

I have specimens from Tatú and San Gabriel (Rio Negro), Brazil; Tahuapunto and Ianarete (Rio Uaupés), Brazil; Río Huayña, Solano (Río Cassiquiare), and Suapure (Río Orinoco), Venezuela, and although the two Peruvian specimens are immature, they obviously belong to *cinerea* as opposed to typical *caniceps*, having a strong yellowish suffusion over most of the under parts, especially in the young female.

The remaining Peruvian species, *leucospodia*, usually considered as belonging to the genus *Elaenia* (*sensu lato*), I believe is far out of place either in *Elaenia* or *Myiopagis* and probably closest to *Phaeomyias* under which I shall discuss it in a future paper.

CORRIGENDA

In No. XXXIII of the present "Studies" (1939, Amer. Mus. Novitates, No. 1045),

p. 23, right hand column, line 27, before "Ecuador," insert: "*E. o. aequatorialis*."

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STUDIES OF PERUVIAN BIRDS. NO. XXXVII¹

THE GENERA *SUBLEGATUS*, *PHAEOMYIAS CAMPTOSTOMA*, *XANTHOMYIAS*, *PHYLLOMYIAS*, AND *TYRANNISCUS*

By JOHN T. ZIMMER

I am greatly indebted to Mr. Rodolphe de Schauensee and Mr. James Bond of the Academy of Natural Sciences of Philadelphia for the loan of certain material that has been of much service in the study of some of the species included in the present paper.

Names of colors are capitalized, as in former papers, when direct comparison has been made with Ridgway's "Color Standards and Color Nomenclature."

Sublegatus modestus modestus (Wied)

M(uscipeta) modesta WIED, 1831, Beitr. Naturg. Bras., III (2), p. 923—Camamú and Bahia, Brazil; type lost.

Elainea Wiedii PELZELN, 1869, Orn. Bras., II, p. 390—new name for *Muscipeta modesta* Wied.

Phylomyia modesta REINHARDT, 1870, Vidensk. Medd. Naturhist. Foren., p. 348—Paracatú and Lagôa Santa, Minas Geraes; cotypes in Copenhagen Mus.

Phylomyias platyrhyncha SCLATER and SALVIN, 1873, Nomencl. Av. Neot., p. 159—Goyaz, Brazil; ♀; British Mus.

? *Sublegatus griseocularis* SCLATER and SALVIN, 1876, P. Z. S. London, p. 17—part; Maranura, Urubamba, Perú; cotypes in British Mus.

The genus *Sublegatus* appears to be far from satisfactorily arranged at present and with nearly one hundred and fifty specimens at hand certain facts become apparent that necessitate revision of the genus.

In the first place, birds from Paraguay and Argentina may be distinguished from southeast-Brazilian examples with a fair degree of certainty and seem to be entitled to bear the name *brevirostris* (D'Orbigny and Lafresnaye, 1837, Mag. Zool., Cl. 2,

"Syn. Av.," p. 49—Corrientes, Argentina). Birds from Goyaz, Pernambuco, Bahia, and Piauí, representing true *modesta*, are characterized, in this analysis, by a slightly warmer color of the upper parts, with the top of the head especially contrastingly browner than the back and with broader dark centers on the crest feathers, but more particularly by relatively dull wing-bars. On the other hand, *brevirostris* has the upper surface averaging a little more grayish or olive-grayish in tone, with the crest somewhat less strongly developed and often more broadly margined with the color of the back, while the wing-bars are sharply whitish. Worn examples of *modestus* may have the wing-bars faded to a resemblance of those of *brevirostris*, but in fresh examples the difference often is pronounced. In *brevirostris*, also, the gray of the chest averages clearer and more sharply contrasted with the yellow of the belly while in *modestus* there usually is a more gradual transition, with the breast dull and somewhat flammulated with yellowish.

Specimens from Chapada, Matto Grosso, are somewhat intermediate although nine of eleven skins in the series from that locality are much closer to *modestus*. Two are nearer *brevirostris*. Of three Bolivian specimens, one each from Mizque and Mission San Antonio may be assigned readily to *brevirostris* while one from farther north, at Trinidad, Río Mamoré, is like the Chapada skins of *modestus*.

Peruvian specimens present a greater problem. Four birds from Santa Ana, Urubamba Valley, are in worn plumage and show the wing-bars rather more pronounced and whitish than do fresher specimens from eastern Brazil, but even in their

¹ Earlier papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 810, 860, 861, 862, 889, 893, 894, 917, 930, 962, 963, 994, 1042, 1043, 1044, 1045, 1066, 1095, and 1108.

abraded condition they agree better with *modestus* than with *brevirostris*. The wing-bars are still a little clouded and not as clear white or yellowish white nor as broad as in either fresh or worn Argentine specimens. Furthermore, the breast is not clear grayish but dull, exactly like *modestus*, and the dark centers of the cap are broader than in most *brevirostris*.

On the other hand, a skin from Chuchurras is closer to *brevirostris* and is discussed below. The apparent conflict in distribution may have its explanation in a migratory movement of *brevirostris* and in support of this possibility, two birds, one from near Manaos, north of the Amazon, and the other from Santa Clara, south of it, may readily be matched by Argentine specimens. The Manaos and Santa Clara birds, the Mission San Antonio skin, and the two Chapada birds are dated in August; the Chuchurras specimen, July. The Argentine, Paraguayan, and (one) Bolivian (Mizque) specimens bear dates from September to April. It seems likely, therefore, that *brevirostris* migrates to the northward in winter and occurs at that time at some places within the range of *modestus* which, in turn, probably is resident where found. The Chuchurras bird, therefore, may go under the following heading.

Sublegatus modestus brevirostris
(D'Orbigny and Lafresnaye)

M(uscipeta) brevirostris D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, Cl. 2, "Syn. Av.," p. 49—Corrientes, rep. Argentina.

E(laenia) brevirostris TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 274—Perú [? = Chanchamayo Valley]; Mus. Neuchâtel.

Sublegatus griseocularis SLATER AND SALVIN, 1878, P. Z. S. London, p. 17—part; Mendoza, Argentina; cotypes in British Mus.

Sublegatus frontalis SILVADORI, 1897, Boll. Mus. Zool. Torino, XII, No. 292, p. 14—Caiza, se. Bolivia.

As noted above, a single specimen from Chuchurras, Perú, agrees with Argentine specimens better than with east-Brazilian and appears to be a migrant of *brevirostris*. The bird is molting into its first adult plumage and still retains some of the immature feathers on the outer part of the wing and on the tail but most of the upper wing-coverts are fresh and show the sharp,

clear tips of *brevirostris*. The top of the head has the dark centers of the feathers very narrow as in some Argentine specimens, and the sides of the head are relatively pale. The chest is not as clear grayish as in most *brevirostris* but has its match in the series of that form.

The allocation of Peruvian records is difficult. Tschudi's "*Elaenia brevirostris*" appears to be a synonym of D'Orbigny and Lafresnaye's earlier "*Muscipeta brevirostris*" though independently described. Taczanowski's characterization of Tschudi's type (or a cotype) as having the throat and chest almost white medially and the wing-bars three in number and broadly white applies best to *brevirostris*.

Slater and Salvin's "*Sublegatus griseocularis*" was published almost without description, being based on two specimens from Maranura, Perú, and two from Mendoza, Argentina, with one of the Mendoza skins bearing a label with the unpublished name adopted by these authors. Taczanowski, however, described one of the Maranura specimens in some detail as having the breast grayish and the two wing-bars pale gray, and he kept "*griseocularis*" both specifically and generically distinct from Tschudi's *brevirostris*! The Maranura specimen thus may have been like the Santa Ana birds at hand, referable to *modestus*.

Berlepsch and Stolzmann record a female from La Merced with a tail so long (66 mm.) that I suspect the specimen in question belongs to a new form of *S. glaber* described on a later page.

These are all the Peruvian records in the genus *Sublegatus*, representing, apparently, three different forms.

Certain Peruvian specimens, from Río Tavera, Perené, and Santa Rosa, are neither *modestus* nor *brevirostris* but are more closely allied to *obscurior*. On account of the complexity of distribution in southern Perú, I think it best to consider *obscurior* and its affines as specifically distinct from the *modestus* group. Both in distribution and taxonomic details, *obscurior* shows affinity to *glaber* and *arenarum* and in the arrangement proposed

here a *glaber* group may be recognized for the forms mentioned.

It must be admitted that the characters that may be taken as specific criteria are not very strong. Both *modestus* and *brevirostris* have the bill extremely stubby and the tail little, if any, paler at the tips of the rectrices and usually only moderately double-rounded. The *glaber* group has a distinctly longer, narrower bill (with the nostrils averaging less broadly exposed), more strongly double-rounded tail, and with the rectrices usually distinctly paler at tips, sometimes quite whitish. The general appearance of both species is, however, very similar and they are obviously very closely related. If the facts of their distribution can be made otherwise intelligible, the two groups need not be kept specifically distinct.

The distribution of forms within the *glaber* group is not perfectly consistent. The specimens from the entire north coast of Venezuela are uniform enough to be referred to *glaber glaber*. This form appears to be recognizable among its conspecifics by relatively large size; moderately dark olive-brown upper surface with the crest long and full and darker than the back; breast rather clear gray and rather abruptly differentiated from the yellow belly though continued a little posteriad on the upper flanks; wing-bars relatively dull and tinged with smoky gray though paler and more conspicuous in worn examples.

North-Colombian specimens (*Empidonax atrirostris* LAWRENCE, 1871, Proc. Acad. Nat. Sci. Phila., p. 234—"Venezuela" = Carthagena, Colombia; Amer. Mus. Nat. Hist.) have the throat and breast distinctly duller, not so clear gray, and graded imperceptibly into the color of the belly; the wing-bars are brighter and the color of the back paler than in the average of *glaber* though still brownish. Specimens from the islands of Bonaire, Curaçao, and Aruba are even more strongly marked in pallor and appear to be worthy of separate recognition as described below. Costa Rican *arenarum* is a little darker and grayer on the back than *atrirostris* but has the anterior under parts light, clear ashy gray, clearer even than in *glaber* and rela-

tively well defined from the yellow of the belly, while the wing-bars are about as in *glaber*, less conspicuous than in *atrirostris*. I cannot see that the top of the head is any more noticeably darker than the back than it is in either *glaber* or *atrirostris*.

Peruvian birds are equivocal as will be discussed below.

Examples from various localities on the middle Orinoco, in Venezuela, are recognizably distinct from north-coastal birds and although the exact geographical line of separation is somewhat doubtful, there appears to be justification for the recognition of a new form as described on a later page.

Coming to *obscurior*, specimens at hand from French Guiana are not uniform but show some agreement in respect to dark olive or even sooty (with a subdued greenish tinge) upper surface, light gray chest, and light, though clear, yellow belly, and with wing-bars only moderately conspicuous. One adult male from Mana is particularly sooty above but four adults, all sexed as males though two are small enough to belong to the other sex, are much brighter above and below, though the upper parts are not as light nor as brownish as those of most *glaber*. They are, however, not far removed from the north-Venezuelan form. Specimens from the upper Rio Negro and several localities south of the lower Amazon in Brazil are equally dark above but much less strongly yellow on the belly and are separated here as a new subspecies. Likewise, the Peruvian specimens differ from the Guianan by paler belly and are further distinguished by paler upper parts, being recognizable as a still different subspecies, described as follows.

Sublegatus glaber peruvianus, new subspecies

TYPE from the Río Tavara, southeastern Perú; altitude 1600 feet. No. 147,737, American Museum of Natural History. Adult male just completing molt (outer rectrices), collected June 6, 1915, by H. and C. Watkins.

DIAGNOSIS.—Most nearly resembles *S. g. obscurior* of French Guiana but with upper parts paler and belly lighter, duller yellow. Differs from *S. g. glaber* of northern Venezuela by lighter upper parts and much paler yellow belly but with throat darker and grayer and gray of breast more gradually merging into the color of the belly.

RANGE.—Apparently restricted to eastern Perú. At present known only from the Río Távara, Río Chanchamayo, and upper Río Ucayali.

DESCRIPTION OF TYPE.—Back a little browner than Deep Grayish Olive but brightening to Grayish Olive on the uropygium; upper tail-coverts browner; top of head with broad dusky brown centers, margined with the color of the back; forehead narrowly pale; lores above whitish, below dusky; a narrow whitish eye-ring; auriculars Mouse Gray \times Deep Olive Gray, passing below into the color of the throat. Chin narrowly whitish; throat Pallid \times Pale Neutral Gray, darkest laterally; belly Naphthalene Yellow; breast like the throat but with indistinct yellowish margins and posteriorly merging into the color of the belly; sides and flanks like the breast but paler. Wings dark fuscous, the secondaries and tertiaries narrowly margined with Pale Olive-Buff, the pale lines on the secondaries not reaching the tips of the coverts; inner primaries with faint suggestions of similar margins; lesser upper wing-coverts like the back but with inconspicuous pale tips; median and greater series with pale tips broader, near Smoke Gray, forming two wing-bars of moderate prominence; inner margins of remiges yellowish white; under wing-coverts Naphthalene Yellow. Tail fuscous brown with broad, dull Smoke Gray tips, not sharply defined. Bill and feet (in dried skin) blackish. Wing, 75 mm.; tail (incomplete) 67.5; exposed culmen, 8; culmen from base, 12; tarsus, 17.

REMARKS.—Female like the male in color but apparently smaller; the single bird of that sex has the wing, 71.5; tail, 63.5. This female is in more worn condition than the type and has the wing-bars and tip of the tail much more conspicuous and whitish.

Sublegatus glaber sordidus, new subspecies

TYPE from Utinga, near Pará, Brazil. No. 148,599, American Museum of Natural History. Adult male collected May 9, 1915, by George K. Cherrie; original No. 19,054.

DIAGNOSIS.—Similar to *S. g. obscurior* of French Guiana but with upper parts more grayish brown; gray of throat and breast averaging darker; belly paler yellow. Differs from *peruvianus* by darker upper parts and anterior under parts.

RANGE.—Amazonian region of Brazil, from Pará west to the Río Tapajoz and extending up the Río Negro to the Río Uaupés.

DESCRIPTION OF TYPE.—Back Hair Brown \times Chaetura Drab, with the margins of the feathers grayer than the dark centers; top of head with the centers darker and more conspicuous, giving a darker appearance to the area; uropygium a

little clearer; upper tail-coverts a little browner. Sides of the head much like the back with a little indication of whitish on upper lores and around the eye; throat Light Neutral Gray; chest about the same but with a faint tinge of pale yellowish; belly whitish only tinged with Marguerite Yellow. Wings dusky brown; secondaries and tertiaries with narrow outer margins leaving a dusky patch beyond the tips of the upper wing-coverts; lesser upper wing-coverts like the back but with inconspicuous, narrow pale tips on the lower feathers; median and greater series with broader tips smoky gray, forming two quite dull wing-bars; under wing-coverts and inner margins of remiges whitish, slightly tinged with yellowish; tail dark brown with indistinctly defined pale tips. Bill and feet (in dried skin) blackish. Wing, 70.5 mm.; tail, 62.25; exposed culmen, 9; culmen from base, 13.5; tarsus, 18.

REMARKS.—Females like the males in color but with shorter wing and tail; wing, 67–70; tail, 56–62. Males measure: wing, 70–75; tail, 61–66. A single bird sexed as a female has the wing, 75; the tail, 65.1, and is probably a male.

Immature birds are brownish above, with the feathers all prominently tipped with dull whitish, preceded by a dusky subterminal mark; the throat and breast are pale grayish or whitish with small, subterminal dusky lunules; belly yellowish white; wings with three sharply defined wing-bars of whitish or yellowish; outer edges of inner remiges more conspicuous than in the adults. The same pattern is found in *modestus* and *brevirostris* as well as in other forms of *glaber*.

This is a very well-marked form in distinction from the *modestus* group and from the other forms of *glaber*, including *obscurior* which is its nearest relative. As noted above, *obscurior* varies in the direction of true *glaber*, with one extreme having a decidedly yellow belly and the other extreme darker above but paler below though the belly is still clear, pale yellow. In the present form, the belly is more whitish than in any specimen I have from French Guiana, with only a tinge of yellow, and the anterior under parts are darker and duller. It is the extreme of dull coloration within the genus as known at present.

Dr. Hellmayr (1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 5, p. 447, footnote b) has recorded specimens from

Obidos and Mexiana as intermediate between *obscurior* and *modestus* but the present series of *sordidus* hardly answers that characterization, having no close resemblance to *modestus*. One specimen from Mexiana, on the other hand, belongs to the *modestus* group. It is very worn but appears to belong to the typical form, *modestus modestus*, and hence probably is resident on Mexiana. It is most like the worn examples from the Urubamba Valley of Perú.

Sublegatus glaber orinocensis, new subspecies

TYPE from Alta Gracia, Río Orinoco, Venezuela. No. 499,767, American Museum of Natural History. Adult male collected December 29, 1897, by George K. Cherrie; original No. 9452.

DIAGNOSIS.—Differs from *S. g. glaber* of northern Venezuela by paler upper parts (on average), by smaller dimensions, and by paler and more sharply defined markings on wing and tail.

RANGE.—Middle Río Orinoco, Venezuela.

DESCRIPTION OF TYPE.—Back near Grayish Olive with some subdued mottling from the darker centers of the feathers; uropygium a little brighter; upper tail-coverts like mantle; top of head with centers of feathers dark brown with grayish Olive edges; forehead narrowly whitish. Lores above whitish, below dusky; a whitish eye-ring and subocular lunule; auriculars near Mouse Gray; throat whitish; breast Pallid X Pale Neutral Gray; belly Barium Yellow; flanks tinged with grayish. Wings dark brown; primaries very narrowly margined with Pale Smoke Gray; secondaries and tertiaries more broadly margined with grayish white; lesser upper wing-coverts like the back but lower ones with pale tips; median and greater series with broader grayish white tips, moderately defined from the brown median portion of the feathers; under wing-coverts Sulphur Yellow; inner margins of remiges narrowly tinged with pale greenish yellow. Tail dusky brown with outer margin of outermost rectrix somewhat pale; tips of all rectrices smoky gray. Bill and feet (in dried skin) blackish ("black" on original label). Wing, 66 mm.; tail, 60; exposed culmen, 8; culmen from base, 12; tarsus, 18.2.

REMARKS.—Females like the males in color but averaging smaller; wing, 62–67.5 mm. (66–68 in males); tail, 56–61 (59–63 in males).

Young birds have the pattern described for young *sordidus* but appear to have the

belly brighter yellow than in that form, as do the adults of *orinocensis*.

While twenty-three birds from Alta Gracia, Caicara, Quiribana de Caicara, and "Agua Salada de Ciudad Bolívar" (taken in January, February, April, and December) are fairly uniform in the characters given for *orinocensis*, five birds from "Ciudad Bolívar" and one from Maripá, Río Caura (dated April, December, and July) approach *glaber glaber* both in size and coloration. There undoubtedly is a junction of ecological habitats near Ciudad Bolívar and it is possible that the two sets of birds may have come from two kinds of country, but only a careful study in the field will elicit this information. The aberrant specimens, all sexed as males, except one immature bird, have the wing 67–69 mm., the tail 61–66, and have a larger bill than most of the other skins, with culmen from base 13–13.5 mm. while *orinocensis* males show 13 mm. The general coloration is close to the more typical *orinocensis*, being paler than most *glaber*, but the wing-bars are broader and duller like those of *glaber*. For the present I can do no more than consider them as aberrant *orinocensis*.

For purposes of comparison, the measurements of some of the series of *glaber* may be included here.

MALES

Venezuela:	Barquismeto, Lara; wing, 75; tail, 70
	El Cuji, Lara; 70.25–75; 64.1–70
	Cumaná; 68–69.1 [72]; 62–63 [64]
	Carúpano; 71–71.5; 61–67
Trinidad:	73; 68
Monos Is.:	70.1; 68

FEMALES

Venezuela:	El Cuji; 70.5–71.25; 66–68
	Puerto Cabello; 65.5; 60
	Cumaná; 69.25; 62
Trinidad:	68.5; 65
Monos Is.:	66.5; 59

It will be noted that the Cumaná birds are smaller than the others although one specimen without given sex is of average size. Even though worn, these birds are browner above than most Orinocoan skins and presumably are true *glaber*. Trinidad

specimens are the brownest of all though nearly matched by some individuals from the mainland. There is no good evidence that there is more than one form in northern Venezuela and the outlying islands to the northeastward.

As intimated earlier, a group of islands off the coast of northwestern Venezuela have a distinct, endemic form that may be known as follows.

Sublegatus glaber pallens, new subspecies

TYPE from Savonet, Curaçao Island. No. 499,782, American Museum of Natural History. Adult male collected June 15, 1892, by Ernst Hartert; original No. 66.

DIAGNOSIS.—Differs from *S. g. glaber* of northern Venezuela by much paler and grayer upper parts, more conspicuous and whiter wing-bars, purer white throat, and paler gray breast and sides. Differs from *S. g. atrirostris* of northern Colombia by similar characters but differences less pronounced; hind neck grayer.

RANGE.—Islands of Aruba, Curaçao, and Bonaire.

DESCRIPTION OF TYPE.—Back Light Grayish Olive with centers of the feathers darker; uropygium brighter, Grayish Olive; upper tail-coverts Hair Brown; top of head with centers of the feathers Olive Brown, broadly edged with olive gray and with sides of head above the eye pale grayish; hind neck Smoke Gray; forehead whitish; upper part of lores and both eyelids white; a dusky spot in front of eye. Chin and throat white; breast broadly whitish, tinged with Pale Olive Gray; sides and upper flanks very little darker gray; belly Barium Yellow X Naphthalene Yellow; lower flanks narrowly obscured with olive. Wings dark brown; primaries finely paler along outer margins; secondaries and tertials more broadly edged with whitish, on secondaries faintly tinged with yellowish and tending to round the tips of the feathers; lesser upper wing-coverts like the back but the lower feathers with paler tips; median and greater series with tips broadly Pale Olive Buff; under wing-coverts Naphthalene Yellow; inner margins of remiges dull, pale yellowish. Tail dark brown with outer margin of outer rectrices paler than the remainder; tips of rectrices somewhat paler than the rest of the feathers (in half of the feathers there are sharp whitish terminal borders, in the remainder not so definite). Bill and feet blackish (in dried skin). Wing, 70.2 mm.; tail, 65; exposed culmen, 9; culmen from base, 13; tarsus 19.

REMARKS.—Female like the male in coloration but smaller; wing, 66.1–67; tail, 60–63.

This form is most like *atrirostris* and, indeed, one specimen of *atrirostris* from

Bonda, Santa Marta, is very like *pallens*, being worn and faded so that the throat and breast are nearly uniform whitish and the belly very pale yellow, but the upper parts are browner than in *pallens* agreeing better with fresh examples from Colombia than with the form described herewith. Fresher Colombian specimens are easily distinguished in the series at hand.

As noted earlier, Panamanian birds are uncertain. The small series at hand from that country shows more resemblance to *atrirostris* than to *arenarum* in the color of the upper parts, and one of two birds from Coiba Island agrees with *atrirostris* also in the color of the under side. The others appear to be darker gray on the chest with better definition between chest and belly, but they are in rather poor condition for exact determination of this feature. For the present I consider them as intermediate between the two forms mentioned.

SPECIMENS EXAMINED

S. m. modestus.—

BRAZIL:

Bahia, Santa Ritta, 1 ♂;
Pernambuco, Rio Branco, 1 ♂;
Piauh, Gilbues, 2 ♂;
Pindahyba, 1 ♀;
Urussuhy, 1 ♀;
Corrente, 1 ♀;
Bello Horizonte, 1 ♀;
Goyaz, Fazenda Esperança, 1 ♂, 1 ♀,
1 "♂";
Isla Mexiana, Santa Maria, 1 ♂;
Matto Grosso, Chapada, 5 ♂, 2 ♀.

BOLIVIA:

Río Mamoré, Trinidad, 1 ♂.

PERÚ:

Santa Ana, 3 ♂, 1 ♀.

S. m. brevisirostris.—

ARGENTINA:

Chaco, Laguna Llema, 1 ♂;
Mocoví, 1 ♀;
Salta, Embarcación, 1 ♀;
Mendoza, San Vicente, 1 ♂, 2 ♀;
Santa Fé, Ocampo, 3 ♂, 1 (?);
Santiago del Estero, Suncho Corral, 1 ♀.

PARAGUAY:

Puerto Pinasco, 1 ♀;
Fort Wheeler, 1 ♀;
west of Puerto Pinasco, 1 (?);
Makthlawaiya, 3 ♂, 2 ♀.

BOLIVIA:

Cochabamba, Mizque, 1 ♂;
Mission San Antonio, 1 ♀.

PERÚ:

Chuchurras, 1 ♀.

BRAZIL:

- Rio Negro, Manaus, 1 ♀;
Villa Bella Imperatriz, Santa Clara, 1 ♀.

S. g. peruvianus.—

PERU:

- Rio Tavera, 1 ♂ (type);
Perené, 1 ♂;
Santa Rosa, 1 ♀.

S. g. sordidus.—

BRAZIL:

- Utinga, 1 ♂ (type), 1 ♀;
Rio Tocantins, Mocajuba, 1 (?);
Rio Tapajoz, Tauary, 1 ♂;
Rio Amazonas, Villa Bella Imperatriz, 2 ♂,
1 ♀;
Rio Negro, Yucabí, 2 ♂, 1 ♀, 1 (?);
Rio Uaupés, Tahuapunto, 1 ♀.

S. g. obscurior.—

FRENCH GUIANA:

- Mana, 1 ♂;
Isle Le Pere, 2 ♂, 2 "♂";
Cayenne, 1 ♀.

S. g. orinocensis.—

VENEZUELA:

- Río Orinoco, Altagracia, 4 ♂ (inc. type),
4 ♀;
Caicara, 6 ♂, 4 ♀;
Quiribana de Caicara, 1 ♀;
Agua Salada de Ciudad Bolívar, 2 ♂;
Ciudad Bolívar, 4 ♂, 2 ♀;
Maripa, 1 ♂.

S. g. glaber.—

VENEZUELA:

- Encontrados, 1 ♀;
Lara, Barquimeto, 1 ♂;
El Cuji, 3 ♂, 2 ♀;
Carabobo, Puerto Cabello, 1 ♀;
Sucre, Cariaco, 1 "♂" [? ♀];
Carúpano, 2 ♂, 1 (?);
Cumaná, 2 (?);
Plain of Cumaná, 2 ♂, 1 ♀.

TRINIDAD:

- Pointe Gourde, 1 ♂, 1 ♀.

MONOS ISLAND: 1 ♂, 1 ♀.

S. g. atrostris.—

COLOMBIA:

- Carthagena, 1 [? ♂] (type);
Algodonal, 1 ♂;
La Playa, 2 ♂;
Santa Marta, 1 [? ♂];
Bonda, 1 [♀], 1 (?).

PANAMÁ:

- Agua Dulce, 1 ♂;
La Colorado, 1 ♀;
Pearl Islands, San José, 2 ♂;
Pearl Islands, Pedro Gonzales, 1 ♀;
Coiba Island, 2 ♂.

S. g. pallens.—

CURAÇAO:

- Savonet, 1 ♂ (type);
St. Christoffel, 1 ♀.

ARUBA: 1 ♀.

BONAIRE: 2 ♀.

S. g. arenarum.—

COSTA RICA:

- Punta Piedra, 3 ♂, 2 ♀.

Phaeomyias murina tumbezana (Taczanowski)

Phyllomyias tumbezana TACZANOWSKI, 1877, P. Z. S. London, p. 325—Tumbez, Perú; ♂; type in Warsaw Mus.; paratype (?) in Vienna Mus.

This grayish form ranges from the Bahia de Caraquez, Ecuador, south to Palambla, Perú. There is a slight possibility of distinction between the birds from the northern and southern parts of this range, but it requires confirmation. Three adults in worn condition and one well-grown immature specimen from north of the Gulf of Guayaquil are paler above than the adults in fresher condition from Alamor and Palambla, but the distinction may well be due to the condition of plumage. A single specimen from Milagros is paler above than most of the Palambla birds but is so nearly like the palest of them that its separation is doubtful. An Alamor bird is among the darkest. For the present, therefore, I refer the entire series to *tumbezana*.

Taczanowski, 1877, P. Z. S. London, p. 752, published a statement by Stolzmann that this was the commonest bird at Tumbez, with a pair in nearly every tree. Nevertheless he collected only the type and a single immature specimen. Jelski collected one bird, now in the British Museum. Watkins visited Tumbez but sent back not one of these birds from that locality. It is hoped that the next ornithologically minded visitor to Tumbez will obtain a series of this reputedly abundant species.

Stolzmann's sight record from Santa Lucia presumably belongs to *tumbezana*.

Phaeomyias murina inflava Chapman

Phaeomyias inflava CHAPMAN, 1924 (June 20). Amer. Mus. Novit. No. 118, p. 10—Virú, Province of La Libertad, northern Perú; ♂; Amer. Mus. Nat. Hist.

This is the most strongly marked form of the species but I think it probably is best kept as a subspecies of *murina*. It is duller in coloration than the other forms, lacking all trace of yellow in the plumage, but in pattern and proportions it has nothing dis-

¹ Specimen in Instituto de La Salle, Bogotá.

tinctive other than that the bill inclines toward a little greater degree of slenderness than in *murina*, *tumbezana*, and *wagae*. In this respect, however, it is surpassed by a new subspecies, described below, which otherwise has the general appearance of the other members of the species *murina*.

Records assignable to *inflava* are from Pacasmayo, San Pedro (de Lloc), Chepen, Minocucho, and Guadalupe.

Various authors have noted the existence of some distinctions between the birds of the coastal regions and those of the middle Marañón Valley, but have not characterized the distinctions in detail. A small series at hand from several localities in that region shows enough difference to warrant the recognition of a new subspecies which may be known as follows.

***Phaeomyias murina maranonica*, new subspecies**

TYPE from Jaen, Río Marañón, northern Perú; altitude 2400 feet. No. 185,853, American Museum of Natural History. Adult male with enlarged gonads collected June 6, 1924, by Harry Watkins; original No. 8094.

DIAGNOSIS.—Nearest to *P. m. wagae* of eastern Perú in the color of the upper parts but rather darker and with a little more obvious dark centers on the feathers and with larger measurements; wing-bars brighter rufescent. Differs from *P. m. tumbezana* of extreme northwestern Perú and western Ecuador by lighter and browner upper parts, less purely grayish chest, and purer whitish throat. Differs from *P. m. inflava* of the neighborhood of Trujillo, western Perú, by less warmly brown back, more sharply marked wing-bars, whitish instead of fulvous outer margins of the inner tertials, yellowish instead of white belly, darker chest and sides, longer bill, and shorter tarsus. The bill has much the shape of that of some *inflava* but is narrower and more elongated than that of the other forms mentioned.

RANGE.—Western side of the valley of the Middle Marañón, including the Chinchipe and the Chamaya, between the Marañón and the eastern side of the Western Andes.

DESCRIPTION OF TYPE.—Back Hair Brown × Olive-Brown with subdued mottling due to darker centers of the feathers; top of head darker and grayer, with a little paler grayish tinge on the forehead; upper part of lores and a broad superciliary stripe dull grayish; a darker area in front of orbit; sides of head dull grayish; auriculars light brownish toward tips; chin and throat centrally dull whitish; malar region darker; breast near Mouse Gray, darker on sides; belly Marguerite Yellow; flanks with

some indistinct, dark stripes. Wings dark brown; primaries with fine outer margins light Hair Brown; secondaries with broader margins Cinnamon-Buff, rounding the tips in a paler tint but not reaching basad quite to the tips of the greater upper wing-coverts; inner tertials with outer margins whitish; upper wing-coverts with tips dark cinnamonaceous, duldest on lesser series, brighter and sharper on median and greater series where they form two prominent wing-bars; under wing-coverts Marguerite Yellow; inner margins of remiges dull, pale buff. Tail dark brown with outer margins of rectrices basally cinnamonaceous brown; tips indistinctly and narrowly pale. Bill (in dried skin) dusky brown, paler at base of mandible; feet blackish. Wing, 65 mm.; tail, 65; exposed culmen 10.75; culmen from base, 14; tarsus, 18.75.

REMARKS.—Female similar to the male in coloration but with shorter wing and tail. Wing, 60–63 mm. (instead of 65–65.25); tail, 57–62.5 (instead of 65).

Two September birds, Saucos (♂) and Huarandosa (♀), are grayer on the back and paler yellowish (nearly whitish) on the belly than the rest of the series dated May and July, and in this respect approach *tumbezana*, but the other characters remain diagnostic.

One bird from Lomo Santo, without given sex, has the wing-markings approaching those of *inflava*, though not quite so uniform and dull, but the yellowish belly distinguishes it at once.

Taczanowski long ago (1884, "Orn. Pér.," II, p. 252) quoted Stolzmann's manuscript notes to the effect that Marañón birds (Guajango) differed from coastal examples (Tumbez, Pacasmayo, and Chepen) by slightly different color, longer bill, and different song. He overlooked the distinction between the Tumbez birds (*tumbezana*) and those from Pacasmayo and Chepen (presumably the later-described *inflava*), but the remark about the difference in the song of the Marañón bird is worthy of further investigation.

***Phaeomyias murina wagae* (Taczanowski)**

Myiopsis Wagae TACZANOWSKI, 1884, Orn. Pér., II, p. 253—Chirimoto, Perú; ♂; type formerly in Warsaw Mus., now lost; paratype in Berlepsch Collection, Frankfurt Mus.

This form is confined, in Perú, to the eastern side of the Eastern Andes and the

Chanchamayo Valley but appears to have a very wide distribution down the Amazon. More than ninety specimens from Teffé to the Rio Tocantins and from the lower Rio Negro to the Jamundá are so like the east-Peruvian birds that I am unable to distinguish them. The much greater series of lower Amazonian birds shows a greater degree of individual variation than is apparent in the small number of Peruvian examples, occasionally having the throat more purely whitish, but, in general, the resemblance is greater than the distinction.

This distribution is of particular interest because it presents a buffer population between *murina murina* of eastern Brazil and *m. incomta* of Venezuela and Colombia, two forms that are very much like each other. Both have the back distinctly rufescent in tone whereas this region is more olivaceous brown in *wagae*. In fresh plumage, *murina* has a deeper tone of yellow on the belly than *incomta*, but in even moderately worn and faded specimens this distinction may be lost.

Specimens from the three Guianas, however, are distinctly more like *wagae* than *incomta* in respect to stronger yellow color on the belly, more olivaceous brown upper parts, yellowish, rather than grayish, breast, and less purely whitish throat. The color of the throat is not a very good character for the separation of *incomta* and *wagae* since worn examples of *wagae* may show no yellowish tinge on the gular area and some fresh examples are not very different from *incomta* in this respect. There seems to be only a slight tinge of yellow in the best examples I have seen, but it is enough to dull the whiteness of the area and give less contrast with the breast which also has a yellowish tinge in this subspecies. In *incomta* it is not often pure white.

The type-locality of *wagae*, Chirimoto, is the only locality among Peruvian records from which I have not seen material. The subspecies appears to be uncommon in Perú.

Four examples from Paraguay and one from northern Argentina may be distinct enough from *wagae* to bear recognition as a separate subspecies. They agree in the

olive color of the upper parts, being quite different from *murina* in that respect, and four of them differ from almost all of the series of *wagae* by their much paler yellowish belly, grayish chest, and pure white throat. However, two of the Peruvian specimens of *wagae* in worn plumage are very similar to the Argentine-Paraguayan birds in fresher plumage and one Paraguayan bird has a strongly yellow belly. It seems hardly possible that the range of *wagae* would cross the tableland to the neighborhood of northern Argentina, particularly since *murina* occupies part of the tableland, in Matto Grosso, but until more evidence is available, I hesitate to separate another form in the south.

Typical *murina* is not constant in the color of the under parts although the rufous tinge of the upper parts holds well throughout the series, with some variation in shading. Fresh birds, as might be expected, are likely to have the belly more strongly yellow than worn specimens but this is not constantly true. Some fresh specimens have the under parts as pale as the Argentine-Paraguayan birds though the upper parts remain rufescent. Were there some geographic allocation possible on this ground, the recognition of another subspecies could be made, but I am unable to discover such consistency. In general the distinction is one of season.

SPECIMENS EXAMINED

P. m. murina.—

BRAZIL:

- Goyaz, Araguaya, 1 ♂, 1 ♀;
- Bahia, Bahia, 2 ♂;
- "Bahia," 1 (?);
- Barra, 1 ♂, 1 ♀, 3 (?);
- Bôa Nova, 2 ♂;
- Jaguauara, 1 ♀;
- Santa Ritta, 1 ♂, 1 ♀;
- Ceará, Viçosa, 3 ♂;
- Piauí, Veados, 1 ♂;
- Urussaty, 1 (♀?);
- Bello Horizonte, 1 (?);
- Pernambuco, Rio Branco, 2 ♂;
- Garanhuns, 2 ♂;
- Palmares, 1 ♀;
- Maranhão, Flores, 1 ♀;
- Manga, 1 ♀;
- Santa Filomena, 1 ♂;
- Pará, Pará, 1 ♀;
- São Paulo, Ypanema, 1 ♂;
- Matto Grosso, Chapada, 3 ♂, 2 ♀, 1 (?).

BOLIVIA:

Sara, "Camp-woods," 2 ♀.

P. m. vagae.—

PERÚ:

La Merced, 1 ♂, 2 ♀;
 Utcuyacu, 1 ♂;
 Río Colorado, 1 ♂¹;
 San Ramón, 3 ♂¹;
 Moyobamba, 3 ♂¹, 2 ♀¹.

BRAZIL:

Rio Amazonas, Teffé, 1 ♂, 5 ♀;
 Rio Madeira, Borba, 1 ♂, 1 ♀;
 Santo Antonio de Guajará, 1 ♂, 2 ♀;
 Villa Bella Imperatriz, 5 ♂, 2 ♀, 1 (?)
 Rio Tapajoz, Tauary, 1 ♂, 3 ♀;
 Urucuritaba, 1 ♀;
 Rio Xingú, Porto de Moz, 1 ♂, 1 ♀;
 Rio Tocantins, Baião, 3 ♂, 1 ♀;
 Rio Jamundá, Faro, 6 ♂, 3 ♀, 1 (?)
 Rio Negro, Igarapé Cacao Pereira, 10 ♂,
 4 ♀, 3 (?)
 Muirapinima, 5 ♂, 6 ♀;
 Manaus, Campos Salles, 5 ♂, 1 ♀;
 Hacienda Rio Negro, 9 ♂, 3 ♀;
 Cravoeira, 1 ♂;
 Tauapessasu, 1 ♀;
 Rio Surumú, Frechal, 1 ♂, 1 ♀;
 Rio Cotinga, Limão, 1 ♀.

FRENCH GUIANA:

Cayenne, 14 ♂, 3 ♀, 1 (?)
 Roche Marie, 3 ♂, 2 ♀;
 Isle Le Pere, 1 ♂.

DUTCH GUIANA:

Kwata, 1 ♀;
 near Paramaribo, 2 ♂, 1 ♀, 3 (?)
 "interior," 1 (?)
 "savanna," 1 (?)

BRITISH GUIANA:

Annai, 1 ♂.

P. m. subsp.?—

PARAGUAY:

Río Negro, 1 ♂;
 east of Caaguassú, 1 ♂;
 Zanja Morotí, 1 ♂;
 80 kil. west of Pinasco, 1 (?)

ARGENTINA:

Jujuy, Perico, 1 ♂.

P. m. inflava.—

PERÚ:

Virú, 7 ♂, 2 ♀;
 Trujillo, 1 ♂, 2 ♀, 1 ♂¹;
 Poroto, 1 ♂;
 Minocucho, 1 ♂¹.

P. m. tumbezana.—

PERÚ:

Palambra, 3 ♂, 3 ♀, 2 (?)
 Milagros, 1 ♀.

ECUADOR:

Alamor, 2 ♂;
 Santa Elena, 2 ♂;
 Chongocito, 1 ♀;
 Bahía de Caraquez, 1 ♀.

P. m. maranonica.—

PERÚ:

Jaen, 1 ♂ (type);
 Saucos, 1 ♂;
 Lomo Santo, 1 ♀, 1 (?)
 Perico, 3 ♀;
 Huarandosa, 1 ♀.

P. m. incomta.—

COLOMBIA:

Carthagena, 1 (?)
 Calamar, 1 ♂, 1 (?)
 Cali, 3 ♂, 4 ♀;
 Honda, 2 ♂, 2 ♀;
 Jiménez, 1 ♂;
 Fusugasugá, 1 ♂;
 Chicoral, 1 ♀;
 "Bogotá," 3 (?)
 Santa Marta, 1 ♂, 1 ♀, 1 (?)
 Cacagualito, 1 ♂, 1 ♀;
 Bonda, 9 ♂, 11 ♀, 25 (?)

PANAMÁ:

El Villano, 1 ♀.

VENEZUELA:

Lara, El Cují, 1 ♂, 1 ♀;
 Falcón, Tucacas, 1 ♂, 1 ♀, 1 (?)
 Cumaná, Plain of Cumaná, 1 ♀;
 Carúpano, 1 (?)
 Cristóbal Colón, 1 ♂;
 Cariaco, 1 ♀;
 Cuchivano, 1 (?)
 Río Orinoco, Caicara, 5 ♂, 2 ♀;
 Quiribana de Caicara, 1 ♂;
 Ciudad Bolívar, 1 ♂, 6 ♀;
 Agua Salada de Ciudad Bolívar, 1 ♂, 1 ♀;
 Altigracia, 3 ♂, 5 ♀;
 Ayacucho, 1 ♂;
 Río Apure, San Fernando, 1 (?)

Phaeomyias leucospodia leucospodia
(Taczanowski)

Elainea leucospodia TACZANOWSKI, 1877,
 P. Z. S. London, p. 325—Tumbez, Perú; type
 formerly in Warsaw Mus., now lost.

Tumbez, 1 ♂, 2 ♀; Samate, 2 ♂, 1 (?)
 Lamor, 1 ♀; Chilaco, 1 ♀; Virú, 5 ♂;
 Tembladera, 1 ♂.

Compared with three examples of *M. l. cinereifrons* from western Ecuador (Santa Elena, Isla Puna, and Isla La Plata). The differences are very slight and not appreciable in worn specimens. Young examples of *leucospodia* have quite pronounced yellow coloration on the lower flanks and under tail-coverts but the adults have only a tinge of such color while adults of *cinereifrons* also have a slight tinge of it though it apparently is less than in *leucospodia*. Furthermore, the sides of the breast in *cinereifrons* are a little darker and clearer (less tinged with drab) than in the typical form and have the back very

¹ Specimens in Field Museum of Natural History, Chicago.

slightly clearer gray. Whether these differences would disappear in a larger series is problematical.

The young of *leucospodia* differ further from the adults by having the wing-bars decidedly broader and paler and, if young enough, may lack all trace of white in the center of the crown. In this condition they have considerable resemblance to the members of the genus *Phaeomyias* although they are paler above than any species of that genus and have the outermost (tenth) primary proportionately longer. There is also considerable resemblance in the scutellation of the "tarsus" since *leucospodia* usually has two to four small scutellae separating the three basal scutellae of the acrotarsium from the hinder edge of the "tarsus" on the inner side. This condition is carried to a still greater extreme in the other species of *Phaeomyias* and, in fact, is not unusual in various genera of the Tyrannidae, but *Elaenia*, where *leucospodia* has long been placed, has a typical exaspidian tarsus, rarely with one or two fine, supernumerary scales developed at the tarsal joint.

The closest point of resemblance between *leucospodia* and the members of the genus *Elaenia* or *Myiopagis* is found in the presence of a white crest and this is hardly a generic character, being absent in some *Elaenia* and not of typical Elaenian form in *leucospodia*.

Thus, while *leucospodia* is not a typical *Phaeomyias*, it appears closer to that genus than to any other and in preference to the erection of a monotypic genus for it, I place it here.

Peruvian records of *leucospodia* are from Chepen, Sullana, Guadalupe, and Paucal.

Camptostoma obsoletum sclateri (Berlepsch and Taczanowski)

Eupsilostoma pusillum SCLATER (not *Myiopatris pusilla* Cabanis and Heine, 1859), 1860, P. Z. S. London, XXVIII, p. 68—Pallatanga, Ecuador; ♀; British Mus.

Ornithion sclateri BERLEPSCH AND TACZANOWSKI, 1883, P. Z. S. London, p. 554—new name for *Eupsilostoma pusillum* Sclater.

Apparently the Peruvian range of this form is restricted to the extreme north-western part of the country. Two Tumbes

birds are fairly typical *sclateri* and twelve specimens from Chilaco, Sullana, Lamor, and Samate, northern Piura, are closer to this form than to any other. These latter birds nearly all show more avellaneous coloration on the upper tail-coverts than the Ecuadorian birds but I am not convinced of the taxonomic value of this character in the present instance. Most of the Ecuadorian birds have the upper tail-coverts a deep olive-buff but some examples have a very definite avellaneous tinge, as strong as that of some of the Peruvian birds although none is as deeply colored as the darkest Peruvian specimen. Individual specimens of some of the other subspecies of *obsoletum* sometimes show a cinnamonaceous or rufous coloration in the posterior feathering similar to that described here or even more pronounced, although I have seen no preponderance of this aberrational tendency in any other single region as exhibited here. If future collections from the region show the constancy of this character, it may be possible to recognize a distinct form for these north-Piura birds, but at present I prefer to place them in *sclateri*.

Camptostoma obsoletum griseum (Carraker)

Camptostoma obsoletum griseum CARRAKER, 1933 (March 24), Proc. Acad. Nat. Sci. Phila., LXXXV, p. 26—Suchimán, Río Santa, Dept. Ancash, Perú; ♂; Acad. Nat. Sci. Phila.

Birds from the coastal region of Perú, from Lima northward to Pacasmayo, are very dull and drab-colored on the anterior under parts, have a less pronounced yellowish tinge on the flanks, and have the wing-bars relatively dull and inconspicuous. Birds from the southern part of this range are the duller of all while those from the north show some approach toward *sclateri*, with stronger and sometimes more rufescent wing-bars and a little brighter tinge of yellow on the flanks. One bird from Lima, one from Poroto, and one from Pacasmayo have the upper tail-coverts warm, cinnamonaceous brown, but on average the feathers of this region are much like the back.

Records that presumably belong to *griseum* are from Chosica, Santa Eulalia,

Minocucho, Trembladera, Paramonga, Yuramarca, and Chicama Valley. Paucal I place here with a slight query in view of the fact that a Palambla bird belongs to *maranonicum* as discussed below.

Camptostoma obsoletum maranonicum
Carriker

Camptostoma obsoletum maronica (sic) [*maranonica* in text] CARRIKER, 1932 (March 24), Proc. Acad. Nat. Sci. Phila., LXXXV, p. 27—San Pedro, lower Río Sihuas, Dept. Ancash, Perú; ♂; Acad. Nat. Sci. Phila.

Birds from the Middle Marañón Valley are grayer above than either *sclateri* or *griseum* and have a minimum of yellowish tinge on the flanks. The chest is pale with a slight grayish tinge and the sides of the breast are gray, without the drab tinge found in *griseum*. The bill averages longer and more slender and has the maxilla paler than in *griseum* or *sclateri* although this distinction is not perfectly diagnostic. The wing-bars are broad and distinct, usually quite rufescent. The forehead is inclined to be somewhat paler than the crown, sometimes even whitish, a variation less commonly noted in the adjacent forms.

This form occupies the Middle Marañón Valley, between the river and the crest of the Western Andes, crossing to the western side of this cordillera at Palambla. Records from Callacate, Guajango, Chusgon, Malea, Soquían, Cochabamba (below Huamachuco), and Hacienda Limón are referable here without much question. I have seen no specimens from east of the Marañón but there are records of "*sclateri*" from Chirimoto, Huambo, and Chachapoyas that are likely to belong here although *olivaceum* is recorded from Tarapoto west of the lower Hualлага.

Camptostoma obsoletum olivaceum (Berlepsch)

Ornithion pusillum olivaceum BERLEPSCH, 1889, Jour. für Orn., XXXVII, p. 301—Iquitos, Perú; ♀; Frankfurt Mus.

Ornithion pusillum juruanum IHERING, 1905, Rev. Mus. Paul., VI, p. 434—Rio Juruá, Brazil.

This brightly colored form appears to be restricted to the Upper Amazonian Valley, almost to northeastern Perú since skins from Tefé belong to *napaeum*. Hell-

mayr, however, found the type of *juruanum* to be closest to *olivaceum* whose range, therefore, may include extreme western Brazil.

Peruvian records are from Iquitos, Tarapoto, and "Upper Ucayali" [= near Cashiboya].

Although *napaeum* has an extensive range over lower Amazonia, on both sides of the Amazon, northward along the Rio Negro and in the neighborhood of Mt. Duida, Venezuela, and in the three Guianas, the birds from northern and central Venezuela are quite readily separable as described below.

Camptostoma obsoletum venezuelae,
new subspecies

TYPE from La Cascabel, Río San Félix, Venezuela. No. 438,789, American Museum of Natural History. Adult male collected May 27, 1907, by George K. Cherrie; original No. 14, 819.

DIAGNOSIS.—Differs from *C. o. napaeum* of the Amazonian region of Brazil by paler and more brownish (less greenish) olive back and more buffy yellow under parts; cap lighter and browner on centers of feathers, less obviously margined with olive.

Differs from *C. o. pusillum* of Santa Marta and adjacent areas in northern Colombia [and northwestern Venezuela] by darker back and cap and usually more obvious dark shading on the sides of the breast.

RANGE.—Central and northern Venezuela and the Island of Trinidad.

DESCRIPTION OF TYPE.—Back and upper tail-coverts Citrine-Drab, a little brighter on the rump; whole top of the head Dark Olive, grading into the color of the back over the hind neck which is most like the back. Lores, eyelids, and a subocular lunule buffy whitish with an indistinctly darker spot in front of the eye; auricular and postocular regions much like the back but paler; throat and breast yellowish Olive-Buff, darker on the sides; chin and upper throat paler; belly Colonial Buff × Primrose Yellow; flanks narrowly a little darker. Wings grayish brown; remiges exteriorly margined with a tint of light grayish olive, narrowest on the primaries and obsolete at the basal end of the secondaries where there is a dark patch; tertiaries with margins broader and paler; lesser upper wing-coverts like the back; median and greater series broadly tipped with Ivory Yellow, forming two distinct wing-bars; under wing-coverts Ivory Yellow × Marguerite Yellow; inner margins of remiges narrowly dull whitish. Rectrices grayish brown, with outer margins like the back and with narrow terminal borders Ivory Yellow. Bill (in dried skin) with maxilla

brown, mandible flesh-color; feet slaty brown. Wing, 54 mm., tail, 40.5; exposed culmen, 7.25; culmen from base, 9; tarsus, 14.

REMARKS.—Females like the males in color but with shorter wing and tail on average. Wing, 46–50 mm. (as against 50–54); tail, 29–36 (as against 32–42.5).

The Venezuelan birds stand out well, both individually and in series, from *napensis*. Most of the series of *venezuelae* have the top of the head predominantly brown, with indistinct, if any, olive margins on the feathers although a few examples have such margins, apparently never as broad and pronounced as in *napensis*. A single specimen, a male from Suapure, has the top of the head sooty rather than brown, approaching *napensis* in this respect.

Birds from southwestern Venezuela, in the neighborhood of Mt. Duida, belong to *napensis* and not to the present form, and Hellmayr (1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 5, p. 459) assigns a specimen from extreme north-western Venezuela (Río Aurare) to *pusillum*.

Four "Bogotá" trade-skins are recognizably distinct from both *pusillum* and *venezuelae*, as well as from *cauca* of the more western parts of Colombia. It is unfortunate that a series of fresh specimens with full data is not available for comparative study, but the characters of the form are of a sort and amount likely to appear equally well in fresher skins. The form may be known as follows.

***Camptostoma obsoletum bogotensis*,
new subspecies**

TYPE from "Bogotá," Colombia, probably from the eastern side of the Eastern Andes. No. 499,933, American Museum of Natural History. Adult without given sex, probably a male, judging by measurements. Collector and date unknown.

DIAGNOSIS.—Nearest to *C. o. venezuelae* in general coloration, having the upper parts more brownish, less greenish, olive and the under parts a little more golden yellow on average than in *C. o. napensis* of Amazonian Brazil, but the dark color of the top of the head is broadly extended over the hind neck and grades into the color of the back on the upper mantle. Wing-bars apparently slightly stronger than in the other two mentioned forms.

RANGE.—Presumably the eastern side of the Eastern Andes of Colombia.

DESCRIPTION OF TYPE.—Back dark Citrine-Drab; top of head and hind neck dark Olive-Brown; lores and circumocular area dull whitish; auricular region Deep Olive-Buff, passing into dull whitish on chin and throat; breast Deep Olive-Buff, tinged with Colonial Buff; belly Primrose Yellow tinged with Colonial Buff. Wings brown; remiges with exterior margins a little grayer than Light Yellowish Olive, narrowest on primaries and not reaching the bases of the secondaries where there is a broad, dark brown patch; tertials with margins broader and paler; lesser upper wing-coverts like the back; median and greater series broadly tipped with Ivory Yellow; under wing-coverts light Colonial Buff; inner margins of remiges yellowish white. Tail brown; outer margins of rectrices brownish olive; tips Ivory Yellow. Maxilla (in dried skin) brown; mandible brownish flesh-color; feet dusky slate. Wing, 53.5 mm.; tail, 38.5; exposed culmen, 7; culmen from base, 10; tarsus, 13.5.

REMARKS.—The evidence as to the probable distribution of this form is found in a worn female from Villavicencio and a specimen without sex from Cunday. The Villavicencio bird, as well as may be determined from its poor condition, is *bogotensis* whereas the bird from Cunday, in the upper Magdalena Valley, is distinctly nearer *cauca*, to which I refer it. It is not typical *cauca*, being grayer on the back than the others of that form at hand, but it has the same sooty crown and gray-tinged breast and sides, and it is closer to the Cauca Valley form than to any other.

On the other hand, a female from Chical, also in the upper Magdalena Valley, is less easily placed. The upper parts are only a little lighter in color than those of *cauca* but the under parts are decidedly brighter and more yellowish, agreeing better with those of *pusillum* of northern Colombia although the upper parts are much too dark. In general appearance, the bird resembles *venezuelae* but association with that form is problematical. Probably this bird is best considered as intermediate between *pusillum* and *cauca*.

There is still some study required of the typical form, *obsoletum*, and its near relative, *cinerascens*. From the material at hand, *cinerascens* appears to range westward from Bahia and Maranhão to northern Matto Grosso while *obsoletum* occupies

an area farther south, from Rio de Janeiro to Rio Grande do Sul and westward an indeterminate distance. A single specimen from Misiones, northeastern Argentina, agrees well with typical *obsoletum*. Birds from Paraguay and northwestern Argentina are as large as *obsoletum* but are not as brightly colored, as a rule, though they are paler below than either *obsoletum* or *cinerascens*. Skins from southern Matto Grosso are much like them in coloration though their size is more like *cinerascens*. It is questionable, however, whether any subspecific distinctions can be maintained for the Paraguayan and Argentine birds.

On the other hand, ten Bolivian specimens show a rather decided differentiation from both typical *obsoletum* and *cinerascens* and may be known as follows.

***Camptostoma obsoletum bolivianum*,
new subspecies**

TYPE from Pulque, Prov. Sucre, Bolivia; altitude 9400 feet. No. 139,457, American Museum of Natural History. Adult male collected November 27, 1915, by Miller and Boyle; original No. 14,436.

DIAGNOSIS.—Similar to *C. o. obsoletum* of southeastern Brazil but distinctly darker and grayer in dorsal coloration, grayer on the chest and less yellowish on the belly; size averaging larger.

RANGE.—Central Bolivia.

DESCRIPTION OF TYPE.—Back Deep Grayish Olive, becoming a little brighter on the rump but again dark on the upper tail-coverts; top of head with broad centers of the feathers Deep Mouse Gray, margined with clearer dark gray; lores dull grayish with a narrow whitish line above connecting with a narrow whitish eye-ring and white subocular lunule; auriculars pale, dull grayish; sides of neck grayer than Smoke Gray. Chin and center of throat dull whitish; sides of throat, breast, and sides washed with Pale Smoke Gray; belly medially white; flanks tinged with Deep Olive-Buff. Wings dark brown; primaries narrowly margined with pale olivaceous gray; secondaries with broader and brighter margins not reaching the tips of the greater wing-coverts; tertiaries with margins broader and more whitish; lesser upper wing-coverts like the back; median and greater series broadly tipped with Cinnamon X Pinkish Cinnamon, forming two conspicuous wing-bars; under wing-coverts Ivory-Yellow X Marguerite Yellow with a brownish area at base of primaries; inner margins of remiges pale yellowish. Tail dark brown with olive outer margins on the rectrices and with inconspicuous and narrow pale tips. Maxilla (in dried skin) blackish; mandible brown, darker at tip; feet

blackish. Wing, 63 mm.; tail, 53; exposed culmen, 8; culmen from base, 11; tarsus, 15.

REMARKS.—Female colored like the male; size not certainly different; wing, 59 mm.; tail, 44.

Most of the Bolivian specimens at hand are sexed as males. One is sexed as a female and one is without given sex. Two of the males are from uncertain places in the Province of Sara, elevations 450 and 750 meters, respectively, and are relatively small (wing, 53.5 and 54 mm., respectively; tail, 43 and 44). They also are a little brighter in color on the back, resembling northwest-Argentine specimens in this respect, though they are small enough to be *cinerascens* if correctly sexed, which is doubtful. The remaining males show the wing 57–63 mm., average, 60.1.

The corresponding figures for the birds of the other regions may be of interest.

	WING	
	MALES	FEMALES
Bahia—Maranhão	56 5–60	52 –59.5
Paraguay	56.5–58	51 –57
n. Argentina,	56 –59	52 –54
s. Matto Grosso	55 –56.5	50.4–54
n. Matto Grosso	50 5–56.5	50.5–56
Rio—R.G. do Sul	52 –57	50 –53.25

SPECIMENS EXAMINED

C. o. obsoletum.—

BRAZIL:

Rio Grande do Sul, Erebangó, 1 ♂;
Lagôa dos Patos, 1 ♀;
Campo Bom, 1 (?);
Sinimbuá, 1 ♂;
Paccaria, 1 ♀;
Nonohay, 1 ♂, 1 (?);
Santa Cruz, 1 ♀;
São Francisco de Paula, 2 ♂;
São Paulo, Ypanemá, 1 ♀;
Victoria, 2 ♂;
Paraná, Roca Nova, 1 ♀;
Rio de Janeiro, Monte Serrat, 1 ♂, 1 (?);
Ponte Maromba, 1 ♂;
Matto Grosso, Tapirapoan, 1 ♂;
Urucum, 1 ♂, 1 ♀;
Belvedere de Urucum, 1 ♀;
Campanario, 1 ♂, 1 ♀;
São Francisco Ranch, 1 (?).

PARAGUAY:

Fort Wheeler, 1 ♂, 1 (?);
Puerto Pinasco, 1 ♀;
La Fonciere, 1 ♀; 1 "♀" [? = ♂], 1 (?);
Zanja Moroti, 1 ♂, 3 ♀, 1 (?);
Ipane River, 1 ♀;
east of Yhú, 1 ♂;
east of Caaguasú, 1 ♂;

upper Rio Igassú, 1 ♂;
 Colonia Independencia, 1 ♂, 1 ♀;
 Makthlawaiya, 1 ♀.

ARGENTINA:

Misiones, Puerto Segundo, 1 ♀;
 Santa Fé, Ocampo, 2 ♂, 2 ♀, 1 "♀"
 [= ♂];
 Tucumán, Tapia, 1 ♀;
 Tafi Viejo, 1 ♂;
 Chaco, Avia Terai, 1 ♂;
 San Vicente, 1 ♂.

C. o. cinerascens.—

BRAZIL:

(No locality = Espirito Santo, Barra do
 Jucú, 1 (?) (type);
 Bahia, Bahia, 1 (?) ;
 Morro de Chapau, 4 ♂, 1 (?) ;
 Tambury, 1 ♂;
 Santa Ritta, 1 ♀, 1 (?) ;
 Bôa Nova, 1 ♂;
 Orobo, 1 ♂;
 Tambury, 1 ♀;
 "Bahia," 4 (?) ;
 Espirito Santo, 1 ♂;
 Ceará, São Pedro, 1 ♂;
 Piahy, Parnaguá, 1 ♂;
 Corrente, 1 ♂;
 Goyaz, Rio Thesouras, 1 ♀;
 Maranhão, Miritiba, 1 ♂;
 Anil, 1 ♀;
 Flores, 1 (?) ;
 Matto Grosso, Chapada, 3 ♂, 5 ♀, 5 (?) .

C. o. bolivianum.—

BOLIVIA:

Sucre, Pulque, 2 ♂ (incl. type);
 Río Cachimayo, 1 ♂;
 Santa Cruz, Valle Grande, 1 ♂;
 Monos, 1 ♂;
 Cordillera, Río Parapeti, 1 ♂;
 Cochabamba, Todos Santos, 1 ♀;
 Mission San Antonio, 1 (?) ;
 Sara, "Camp Woods," 2 ♂.

C. o. maranonicum.—

PERÚ:

Pucará, 1 ♂;
 Huancabamba, 1 ♂, 1 ♀;
 San Ignacio, 1 ♀;
 Huarandosa, 1 ♂;
 Perico, 1 ♂, 3 (?) ;
 Saucos, 1 ♂;
 Sondorillo, 1 (?) ;
 Lomo Santo, 1 ♂, 1 ♀;
 Cabico, 2 ♀;
 Jaen, 1 ♂, 1 ♀;
 Vifia, 3 ♂, 2 ♀;
 Palambra, 1 ♀.

C. o. griseum.—

PERÚ:

Lima, 1 ♂, 2 ♀;
 Huaral, 7 ♂, 5 ♀, 2 (?) ;
 Huacho, 4 ♂, 3 ♀, 1 (?) ;
 Sayan, 1 ♂;
 Vitarte, 4 ♂, 1 ♀;
 Poroto, 2 ♂, 1 ♀;
 Trujillo, 2 ♂, 1 ♀, 2 (?) ;
 Virú, 1 ♂, 3 ♀, 1 (?) ;

Choquisongo, 1 (?) ;
 Pacasmayo, 2 ♂.

C. o. solateri.—

PERÚ:

Chilaco, 1 ♂, 1 ♀, 2 (?) ;
 Sullana, 1 ♂, 2 ♀;
 Lamor, 2 ♀, 1 (?) ;
 Somate, 1 ♂, 1 ♀;
 Tumbes, 1 ♂, 1 ♀.

ECUADOR:

Esmeraldas, 1 ♀;
 Paramba, 1 ♂, 2 ♀;
 Valle de Cumbaya, 1 ♂;
 Valle Tumbaco, 1 ♂;
 Duran, 5 ♂;
 Isla Puna, 1 ♂, 1 ♀, 2 (?) ;
 Manaví, 2 ♂, 1 ♀;
 Chone, 4 ♀;
 Bahia de Carques, 1 ♀;
 Bucay, 1 ♀;
 Casanga, 1 ♂;
 Río Pindo, 1 ♂;
 Chimbo, 2 ♂;
 Santa Rosa, 4 ♂, 2 ♀, 1 (?) ;
 Cebollal, 2 ♂;
 Río Jubones, 1 ♂;
 Portovelo, 2 ♂;
 Lunamá, 1 ♂;
 Chongocito, 1 ♂, 1 ♀;
 Río Jubones, 1 ♂;
 Guayaquil, 2 ♀;
 Alamor, 1 ♀.

C. o. olivaceum.—

PERÚ:

Orosa, 1 ♂;
 Apayacu, 2 ♀;
 Puerto Indiana, 2 ♀.

C. o. napaeum.—

BRAZIL:

Teffé, 1 ♂, 1 ♀;
 Rio Madeira, Rosarinho, 5 ♂, 2 ♀;
 Borba, 1 ♂;
 Igarapé Auará, 1 (?) ;
 Rio Amazonas, Villa Bella Imperatriz, 5 ♂,
 2 ♀, 1 (?) ;
 Rio Tapajoz, Caxiricatuba, 1 ♂, 2 ♀;
 Igarapé Amorin, 2 ♂, 1 ♀;
 Aramanay, 1 ♂;
 Igarapé Brabo, 1 (?) ;
 Rio Xingú, Tapará, 1 ♀, 1 (?) ;
 Rio Tocantins, Baião, 1 ♂, 2 ♀;
 Mocajuba, 1 (?) ;
 Pará, Utinga, 1 ♂, 2 ♀;
 Prata, 1 ♂;
 Rio Maicuru, 1 ♀;
 Isla Marajó, São José, 1 ♂;
 Rio Jamundá, Faro, 1 ♂, 5 ♀, 1 (?) ;
 Rio Negro, Manaos, 5 ♂, 2 ♀;
 Igarapé Cacao Pereira, 4 ♂, 2 ♀, 1 (?) ;
 Yucabí, 1 ♂, 1 ♀;
 Santa Isabel, 1 ♂, 1 ♀.

BRITISH GUIANA:

Rockstone, 1 ♂;
 Potaro Landing, 1 ♀.

DUTCH GUIANA:

Paramaribo, 4 ♂, 5 ♀, 2 (?);

Kwata, 2 ♂, 1 (?).

FRENCH GUIANA:

Cayenne, 2 ♂, 2 ♀;

Roche Marie, 1 ♂.

VENEZUELA:

Río Orinoco, Ayacucho, 1 ♂, 1 ♀;

Esmeralda, 1 ♂, 3 ♀;

Lalaja, 1 ♂, 1 ♀;

Mt. Duida, Valle de los Monos, 1 ♀.

C. o. venezuelae.—

VENEZUELA:

Río San Felix, La Cascabel, 1 ♂ (type);

Río Orinoco, Caicara, 5 ♂, 4 ♀, 1 (?);

Altigracia, 2 ♂, 3 ♀, 2 (?);

Ciudad Bolívar, 1 ♂, 3 (?);

Agua Salda de Ciudad Bolívar, 1 ♀;

Suapure, 2 ♂, 3 ♀;

Maripa, 1 ♀;

Río Caura, La Prición, 1 ♀;

Río Apure, San Fernando, 1 (?);

Cumaná, San Fernando, 1 "♂" [? = ♀];

Bermúdez, Cumanacoa, 2 ♀;

Rincón San Antonio, 1 "♀" [? = ♂];

San Antonio, 2 ♂;

Cocallar, 1 ♂;

El Pilar, 1 ♂;

Falcon, Tucacas, 1 ♂;

Carabobo, Las Trincheras, 1 ♀;

"Venezuela," 1 (?).

TRINIDAD:

Caparo, 2 ♂, 3 ♀;

Princetown, 3 ♀;

Heights of Aripo, 1 ♀;

Geelet, 1 ♀;

"Trinidad," 1 (?).

C. o. pusillum.—

COLOMBIA:

Río Atrato, 1 ♂;

Río Magdalena, Banco, 1 ♀;

Carpintero, 1 ♀;

Algodonal, 1 ♀;

Santa Marta, Bonda, 1 ♀, 5 (?).

C. o. bogotensis.—

COLOMBIA:

"Bogotá," 4 (?) (incl. type);

Villavicencio, 1 ♀.

C. o. caucae.—

COLOMBIA:

Río Frío, 2 ♂ (incl. type);

east of Palmira, 1 ♂, 1 (?);

Media Luna, 1 ♂;

Cunday, 1 (?);

Río Coello, Chicoral, 1 ♀ (× *pusillum*).

Xanthomyias sclateri subtropicalis
(Chapman)

Mecocerculus subtropicalis CHAPMAN, 1919
(Dec. 31), Proc. Biol. Soc. Wash., XXXII, p.
262—San Miguel Bridge, Urubamba Valley,
Perú; ♂; U. S. Nat. Mus.

Idma, 1 ♂, 2 ♀; San Miguel, 1 ♂, 1 (?)
[= ♂].

This well-marked form seemingly is
confined to the Urubamba Valley.

Phyllomyias griseiceps griseiceps (Scla-
ter and Salvin)

Tyranniscus griseiceps SCLATER AND SALVIN,
1871, P. Z. S. London for 1870, p. 841—Baba-
hoyo, Ecuador; British Mus.

Twenty-nine examples of this rather un-
common species show sufficient differentia-
tion in various parts of the entire range
that I believe several subspecies ought to
be recognized. All the birds from western
Ecuador, true *griseiceps*, are characterized
by the strong sooty crest indistinctly mar-
gined with dark gray and with the dark
shading carried well over the hind neck to
the upper border of the mantle; the back
is clear olive, rarely with a trace of darker
centers on the feathers; the throat is
broadly white. They differ from *P. g.*
cristatus of northeastern Colombia by
grayer and shorter crest with less obvious
dark centers.

Chapman's *caucae* (1915, Bull. Amer.
Mus. Nat. Hist., XXXIV, p. 645—Mira-
flores, Colombia; ♂; Amer. Mus. Nat.
Hist.) is a larger bird with definite dark
centers on the feathers of the mantle which
thus is less differentiated from the top of
the head than in the Ecuadorian series.
The higher elevations at which the two
known specimens were found (6800 and
7000 feet) furnish added weight to the ap-
parent distinctions of *caucae*.

The other Colombian specimens com-
prise nine examples from the Bogotá region
and two from Minca, Santa Marta, all of
which differ from both *caucae* and *grisei-
ceps* by having the dark centers of the
crest-feathers narrower and the light edges
broader and paler with a consequent ap-
pearance of spotting that is absent from
the other forms. The centers of the
feathers, moreover, are not as blackish as
in *caucae* and *griseiceps* but have a decided
brownish tone even in unworn plumage.
Occasionally there is a slight trace of
olivaceous color on the margins of some of
the crest-feathers but in most of them the
margins are light gray. Though the crest
is long, the hind neck is grayish or olive,
not sooty like the crest.

Berlepsch (1884, Jour. für Orn., XXXII,
p. 250) described *Phyllomyias cristatus*
from Bucaramanga, Colombia, distinguish-

ing it from *griseiceps* by reason of its brownish crest, margined with grayish olive, and a yellowish throat, with only the chin whitish. Recent authors have not recognized the form as distinct. Nevertheless, Bucaramanga lies between Bogotá and Santa Marta and with Bogotá and Santa Marta specimens similar, it would be expected that the same form would be found at Bucaramanga. Some of the Bogotá birds have the throat less purely white than the chin, all have the crown brownish rather than sooty blackish, and I have mentioned the occurrence of an olive tinge on the margins of the posterior crest-feathers in some cases. It seems advisable, therefore, to adopt the name *cristatus* for the birds of this general region.

One "Bogotá" specimen has traces of immature plumage which show the crest-feathers light, warm brown finely tipped with white and have broad whitish tips on the greater upper wing-coverts.

A single specimen from the Lawrence Collection, without data, is very strongly marked in the characters of *cristatus*, going far beyond any specimen I have from Bogotá or Santa Marta. The top of the head is quite pale brown with strongly olivaceous margins; the whole under parts are yellow, with even the chin of that color though it is paler than the throat; the auriculars are yellowish instead of white and the superciliary stripe has a suggestion of yellow. This may be an extreme development of *cristatus* or it may belong to an unknown form from an unknown locality.

One specimen from Zamora, eastern Ecuador, differs from the west-Ecuadorian birds principally by a restriction of the dark hue of the cap to the top of the head, leaving the hind neck greenish, but the hue of the crest is as dusky as in the palest of the western birds and I am not convinced that a separable form is involved.

On the other hand, a single specimen from the lower Rio Negro, Brazil, the first example to come from that particular region, is distinct enough from Ecuadorian and Colombian birds to warrant subspecific separation. Supporting the proposed separation, a number of specimens from apparently associated localities show the same

general features of the Rio Negro bird within certain limits of individual variation. The new form may be known as follows.

***Phyllomyias griseiceps pallidiceps*, new subspecies**

TYPE from Hacienda Rio Negro, Manaos, Rio Negro, Brazil. No. 309,969, American Museum of Natural History. Adult male collected July 20, 1928, by Carlos Olalla and sons.

DIAGNOSIS.—Distinguishable from *P. g. griseiceps* of western Ecuador by paler cap, predominantly grayish with the dark centers reduced to inconspicuous shaft-lines; crest shorter; hind neck like the back, not like the top of the head.

RANGE.—Lower Rio Negro, Brazil; south-eastern Venezuela (Mt. Auyan-tepui and probably Mt. Roraima); probably British Guiana; Chanchamayo Valley, Perú.

DESCRIPTION OF TYPE.—Top of head near Deep Neutral Gray with fine shaft-lines darker; a slight suggestion of olive tinge on the edges of the occipital feathers; crest moderately developed; back slightly grayer than Krönberg's Green, the same color covering the hind neck; upper part of lores and a narrow superciliary stripe whitish; a broad dusky space before and behind the orbit; subocular lunule white; malar and auricular regions grayish white; chin whitish; throat tinged with pale yellow; breast and sides dull Mignonette Green with brighter yellow edges on the central feathers; belly Citron Yellow with a slight tinge of Straw Yellow; under tail-coverts paler and duller. Wings sooty brown; secondaries exteriorly margined with Primrose Yellow, not reaching the tips of the greater upper coverts but reaching the shaft at the terminal margin in a more whitish tint; tertials with outer margins whitish; lesser upper wing-coverts like the back; median and greater series with tips Citrine Drab forming inconspicuous wing-bars; under wing-coverts Marguerite Yellow; inner margins of remiges dull yellowish; tail dark brown with outer margins of rectrices olive. Bill and feet (in dried skin) blackish. Wing, 48 mm.; tail, 41; exposed culmen, 7; culmen from base, 9; tarsus, 14.

REMARKS.—Female (from Mt. Auyan-tepui) like the male.

One male from Mt. Auyan-tepui and one from Perené, Perú, have the chest duller grayish olive than the rest of the series, with the throat less whitish. One Auyan-tepui female has the throat as whitish as the type, and three of the Venezuelan specimens have only the chin white but the rest of the under parts as bright as, or brighter than, the type. The Venezuelan

male and the Perené male have the top of the head more brownish than the others but this area is worn in both specimens while fresh in the remainder of the series. I have little hesitation, therefore, in assigning the Venezuelan and Peruvian birds to this new form. Individually and in series they show good distinction from the west-Ecuadorian *griseiceps*. It is highly probable that the records from Annai, British Guiana, and from Mt. Roraima are assignable to the same form. There are no earlier Peruvian records except of the specimens listed below.

I am unable to say what the birds recorded from Carahobo and Lake Valencia, Venezuela, may be. The specimens should be examined to determine their proper allocation.

SPECIMENS EXAMINED

P. g. griseiceps.—

ECUADOR:

- Esmeraldas, 2 ♀;
- Cebollal, 2 ♂;
- Hacienda Ana Maria, Quevedo, 1 ♂;
- "Quito," 1 (?);
- "Ecuador," 1 (?);
- Zamora, 1 ♀.

P. g. caucacae.—

COLOMBIA:

- Miraflores, 1 ♂ (type);
- San Antonio, 1 ♀.

P. g. cristatus.—

COLOMBIA:

- Cunday, 1 (?);
- "Bogotá," 8 (?);
- Santa Marta, Minca, 1 ♂, 1 (?).

P. g. pallidiceps.—

BRAZIL:

- Manaos, Hacienda Rio Negro, 1 ♂ (type).

VENEZUELA:

- Mt. Auyan-tepui, 1 ♂, 3 ♀, 1 (?).

PERU:

- Perené, 1 ♂;
- Rio Colorado, Chanchamayo, 1 ♂.

P. g. subsp. ?.—

- (No locality), 1 (?).

Tyranniscus nigro-capillus nigro-capillus (Lafresnaye)

Tyrannulus nigro-capillus LAFRESNAYE, 1845, Rev. Zool., VIII, p. 341—Bogotá, Colombia.

Five specimens from northern Perú are inseparable from Ecuadorian and Colombian birds (except from *flavimentum* of the Santa Marta region of northern

Colombia) although old Bogotá trade-skins have browner caps.

I have seen no specimens from central Perú which Taczanowski (1884, Orn. Pér., II, p. 257) noted as differing slightly from north-Peruvian specimens.

On the other hand, ten specimens from the Mérida region of western Venezuela are easily separable from the type and three other examples of *flavimentum* and may be recognized as described below.

Peruvian records of *nigro-capillus* are from Cutervo, Molinopampa, and Puma-marca.

Tyranniscus nigro-capillus aureus, new subspecies

TYPE from Escorial, near Mérida, Venezuela; altitude 2500 meters. No. 499,977, American Museum of Natural History. Adult male collected February 22, 1896, by Salomon Briceño and Sons.

DIAGNOSIS.—Nearest to *T. n. flavimentum* of the Santa Marta region, Colombia, but more golden in coloration. Back more yellowish green; under parts more chrome-tinged yellow; top of head lighter and more brownish, less sooty.

RANGE.—At present known only from the region of Mérida, Venezuela.

DESCRIPTION OF TYPE.—Top of head dark Clove Brown; nasal feathering, upper part of lores, and a superciliary stripe Olive Yellow, becoming darker and greener posteriorly; back Warbler Green × Citrine, passing into Citrine on the upper tail-coverts. A dusky spot in front of eye; sides of head Yellowish Citrine; throat, breast, and belly Strontian Yellow × Wax Yellow; chin and throat similar but with white subterminal area of the feathers lightening the general hue. Wings fuscous; primaries with fine outer margins pale olivaceous; secondaries with broader outer margins Old Gold, leaving a dusky patch just beyond the tips of the greater wing-coverts; tertials with outer margins Naphthalene Yellow; lesser upper wing-coverts like the back; median and greater series with broad terminal spots of Naphthalene Yellow forming two conspicuous wing-bars; under wing-coverts Barium Yellow, deeper and more golden on bend of wing; inner margins of remiges dull buffy whitish. Tail light brown with outer margins of the rectrices near Citrine. Bill (in dried skin) dusky brown; feet dark brown. Wing, 65 mm.; tail, 49; exposed culmen, 6.8; culmen from base, 10; tarsus, 17.

REMARKS.—Female like the male.

An immature bird from El Valle, July 7, 1896, ♀, has the top of the head dull

¹ Specimen in Field Museum of Natural History, Chicago.

brownish, the back dull greenish, the rump and upper tail-coverts distinctly brown, the under parts duller than in the adults and with a slight buffy tinge, the wing-bars near Isabella Color, and the outer margins of the secondaries golden brown.

SPECIMENS EXAMINED

T. n. nigro-capillus.—

PERÚ:

Taulis, 1 ♂;
La Lejía, 1 ♂, 2 ♀, 1 (?).

ECUADOR:

Pichincha, 1 ♂;
upper Sumaco, 2 ♀.

COLOMBIA:

Almaguer, 1 ♂;
Santa Elena, 3 ♀;
Salento, 1 ♂;
coast range west of Popayan, 1 ♀;
Fomeque, 1 (?);
Páramo de Chingosa, 1 (?);
"Bogotá," 13 (?).

T. m. flavimentum.—

COLOMBIA:

Santa Marta, San Lorenzo, 1 ♂ (type);
El Libano, 1 ♀, 2 (?).

T. n. aureus.—

VENEZUELA:

Escorial, 2 ♂ (incl. type), 4 ♀;
El Valle, 2 ♂, 1 ♀;
El Loro, 1 ♀.

Tyranniscus uropygialis (Lawrence)

Mecocerculus uropygialis LAWRENCE, 1870, Ann. Lyc. Nat. Hist. N. Y., IX, p. 266—"supposed to be Ecuador"; Amer. Mus. Nat. Hist.

Chipa, 1 ♀.

I can find no distinctions in birds from Bogotá, northern and southern Ecuador, and Perú. The type is very warmly colored on the whole upper surface, particularly bright on the uropygium, but this coloration presumably is due to postmortem change in the specimen.

Peruvian records are from Ollachea, Tabaconas, mountains above Huánuco, and Surco.

Tyranniscus cinereiceps (Sclater)

Tyrannulus cinereiceps SCLATER, 1860, P. Z. S. London, XXVIII, p. 69—Pallatanga, Ecuador: ♀; British Mus.

I have not enough material to explain satisfactorily the variations that appear in a series of twelve birds from various localities in Colombia, Ecuador, and Perú. The Ecuadorian, east-Colombian, and north-Peruvian (Chaupe) birds are in

good agreement, having the under parts deep yellow (except in one young specimen) and the base of the auriculars similarly brightly colored.

Two specimens from the Urubamba Valley are distinctly duller yellow on the belly and less strongly greenish on the chest, but they are very closely matched by a single specimen from Santa Elena, Colombia. Two other Colombian birds, an adult from above Salento and an immature bird from El Eden, are decidedly pale yellowish on the under parts and strongly tinged with grayish on the back. The Urubamba Valley skins and the Santa Elena specimen have particularly small, slender bills; all the other examples have heavier bills. The value of these characters is in question until more material from all parts of the range is available.

Another Peruvian record is from Ropayhamba.

SPECIMENS EXAMINED

T. cinereiceps.—

COLOMBIA:

El Roble, 1 (?);
Santa Elena, 1 ♂;
El Eden, 1 ♂;
above Salento, 1 ♀;
"Bogotá," 1 (?).

ECUADOR:

Intag, 2 ♂;
upper Sumaco, 1 ♀;
above Baeza, 1 ♂.

PERÚ:

Chaupe, 1 ♀;
San Miguel, 1 ♂;
Idma, 1 ♂;
Río Jelashte, 1 ♂¹.

Tyranniscus bolivianus viridissimus

Sclater

Tyranniscus viridissimus SCLATER, 1874, P. Z. S. London for 1873, pp. 780, 782—Cosñipata, Perú; British Mus.

It is with considerable hesitation that I recognize *viridissimus* as distinct from *bolivianus*. Three females from Idma and one from Santo Domingo are brighter green above and brighter yellow below than any of five Bolivian birds of the same sex although one female from Roquefalta, Cochabamba, approaches the dullest of the Peruvian birds. On the other hand, a

¹ Specimen in Academy of Natural Sciences of Philadelphia.

male from Idma and one from La Pampa are rather exactly like a male from Inca-chaca and one from Sandillani while a Yungas male and two of that sex from Locotal are grayer and duller above and below.

Hellmayr (1920, Arch. Naturg., LXXXV, A, Heft 10, p. 53) found a male from "Chuhuasi" [= Uruhuasi] like Bolivian birds but a male from Idma, Urubamba Valley, a little brighter in color. He later assigned the "Chuhuasi" specimen to *bolivianus* and the Idma bird to *viridissimus*. The type locality of *viridissimus* is more closely associated with Uruhuasi than with Idma and there is little likelihood of taxonomic distinction between the two places. Furthermore, the Santo Domingo female now before me is inseparable from Idma specimens.

It appears, therefore, that there is a tendency toward brighter coloration in the Peruvian birds, particularly noticeable in the females and, although there is some doubt as to the advisability of maintaining two forms, *viridissimus* may be provisionally recognized. The geographic boundary also is a matter for debate but the material at hand suggests that this boundary may nearly coincide with the political one between Perú and Bolivia.

With this arrangement, the Uruhuasi record should go with *viridissimus*.

SPECIMENS EXAMINED

T. b. bolivianus.—

BOLIVIA:

- Chaco (Yungas), 1 ♂, 2 ♀;
- Sandillani, 1 [♂];
- Pitiguaya, 1 [♀];
- Locotal, 2 ♂, 1 [♀];
- Incachaca, 1 ♂;
- Roquefalta, 1 ♀.

T. b. viridissimus.—

PERÚ:

- La Pampa, 1 ♂;
- Santo Domingo, 1 ♂;
- Idma, 1 ♂, 3 ♀.

Tyranniscus chrysops chrysops (Sclater)

Tyrannulus chrysops SCLATER, 1858, P. Z. S. London, XXVI, p. 458—Gualaquiza and Zamora, Ecuador; cotypes in British Mus.

T. (Tyranniscus) flavifrons CABANIS AND HEINE, 1859, Mus. Hein., II, p. 58, footnote—Bogotá; Frankfurt Mus.

Typical *chrysops* from eastern Ecuador

is a relatively brightly colored bird, with the upper parts bright olive-green (darker on the head), the forehead deep yellow and the superciliary stripe broadly of the same color, the chin strongly yellow, and the belly nearly always definitely yellowish. The tips of most of the rectrices are noticeably pale.

Specimens from northern Perú and the eastern Andes of Colombia agree very well with the east-Ecuadorian specimens although an occasional specimen shows a darker upper surface, duller frontal band, or more whitish under parts.

Birds from southwestern Ecuador are distinctly darker above (Roman Green × Dark Greenish Olive), with the forehead duller yellowish, frequently obscured by dark tips on many of the feathers, and with the superciliary stripe duller and narrower, sometimes confined to the upper eyelid; the under parts are sometimes like those of *chrysops*, sometimes less strongly yellowish in an apparent approach toward *albigularis* of northwestern Ecuador. The tips of the rectrices are indistinctly, if at all, pale. Since there is a name available for a form from this region, *flavidifrons* (*Tyrannulus flavidifrons* Sclater, 1860, P. Z. S. London, XXVIII, p. 69—Pallatanga, western Ecuador; ♂♂; cotypes in British Mus.), it may be used in this case. *T. c. flavidifrons* (Sclater) probably occurs in Perú since I have specimens from the border of Perú and Ecuador though none from localities definitely within the boundaries of Perú.

Specimens from central and western Colombia are slightly different from the east-Colombian birds when examined in series, but the distinctions are not clearly enough defined to justify the separation of a new form in this area. The central and western birds are a little darker on the back, suggesting the paler examples of *flavidifrons*, but the yellow front and superciliary stripe are better developed on average and the tips of the rectrices are distinctly pale as in *chrysops*. Though seemingly intermediate between *chrysops* and *flavidifrons*, this dark population is separated from the range of *flavidifrons* by the range of *albigularis*. I believe it best,

therefore, to keep all the Colombian birds together in *chrysops* except, of course, the Santa Martán *minimus* which, in Colombia, is confined to the Santa Martán region. I suspect that Santa Marta comprises the entire range of this form since available Venezuelan examples appear to be recognizably distinct as described below.

Peruvian records of *chrysops* are from Huambo, Huayabamba, Ray-Urmana, Chirimoto, and Poco Tambo (Pucatanambo).

***Tyranniscus chrysops cumanensis*, new subspecies**

TYPE from Los Dos Rios, State of Cumaná, Venezuela. No. 500,044, American Museum of Natural History. Adult male collected April 3, 1898, by Caracciola; original No. 1226.

DIAGNOSIS.—Agrees with *T. c. minimus* of the Santa Martán region of northern Colombia in respect to size and the relative inconspicuousness of the yellow frontal band, but differs from it by distinctly brighter, more yellowish coloration above and below, being the brightest of the forms known at present.

RANGE.—Northeastern Venezuela.

DESCRIPTION OF TYPE.—Back light Olive-Green × Serpentine Green; top of head a little darker; forehead narrowly rather dull yellow (a little more golden than Reed Yellow), not sharply defined; lores slightly duller and a narrow superciliary line still paler and not very distinct; auriculars and upper tail-coverts with a slight brownish tinge. Chin near Reed Yellow; throat a little deeper, pale Primrose Yellow; breast Olive-Buff with indistinct yellowish flammulations; belly Primrose Yellow with some dull, pale grayish striping anteriorly and laterally, merging with the color of the breast, and with traces of Reed Yellow flammulations; flanks a little grayer than Light Yellowish Olive. Wings dark brown; ninth (subexternal) to sixth primaries with basal third of outer margins narrowly Sea-foam Yellow; tenth and fifth to first without pale outer margins; secondaries with outer margins more broadly Olive-Yellow except at the bases of the outer three or four and more greenish at the bases of the others; tertials margined with Primrose Yellow; lesser upper wing-coverts like the back; median and greater series with outer margins and tips bright Primrose Yellow; under wing-coverts Marguerite Yellow except for a brownish patch at the base of the primaries; inner margins of remiges Pale Olive-Buff. Tail lighter brown than the wings with outer margins of the rectrices near Light Yellowish Olive. Bill (in dried skin) blackish; feet dark brown. Wing, 51.5 mm.; tail, 45; exposed culmen, 7; culmen from base, 10; tarsus, 16.

REMARKS.—Females similar to the males

in coloration but with distinctly shorter wing and tail. Wing, 44.5–48; tail, 36–38. Males: wing, 50–53; tail, 40–45.

Five birds in the series of fifteen specimens appear to be wrongly sexed. The evidence of a long series of the entire species leaves little doubt that there is a positive difference of size in the two sexes. On the same basis, the type of *minimus* is a female and not a male as noted on the original label.

A specimen, presumably a female, obtained by Alexander and labeled as from British Guiana, belongs to *cumanensis* without question but is doubtful as to locality. I have never succeeded in tracing Alexander's itinerary but have found various species, from time to time, whose right to inclusion in the fauna of British Guiana is based solely on the unsupported evidence of specimens labeled, briefly, like the present bird, "Alexander, British Guiana."

SPECIMENS EXAMINED

T. c. chrysops.—

PERÚ:

La Lejía, 2 ♂;
Uchco, 1 ♂;
Nuevo Loreto, 1 (?).

ECUADOR:

Zamora, 4 ♂, 1 ♀;
Baeza, 2 ♂, 1 ♀;
Oyacachi, 3 ♀, 1 (?).

COLOMBIA:

(Santa Elena, San Antonio, Primavera, Las Lomitas, Los Cisneros, Honda, Aguadita, Ricaurte, Villavicencio, Buena Vista, Fusugasugá, Chocó, Gallera, Puerto Valdivia, "Yuntas" [? = Juntas de Tamaná], Río Frío, La Palma, east of Palmira, Quinta, "Río Cauca," and "Bogotá"), 13 ♂, 18 ♀, 15 (?).

T. c. flavidifrons.—

ECUADOR:

Alamor, 6 ♂, 6 ♀, 1 (?);
Punta Santa Ana, 1 ♂, 2 ♀;
Las Piñas, 1 ♂, 2 ♀;
Cebolla, 6 ♂;
El Chiral, 2 ♀;
Pallatanga, 1 ♂;
Pullango, 1 ♂;
Chimbo, 1 ♂, 1 (?).

T. c. albigularis.—

ECUADOR:

Mindo, 2 ♂, 2 ♀;
Esmeraldas, 1 ♂ (type);
Río de Oro, 1 ♂;
Guala, 1 ♂;
Guaracilla, 1 ♂, 2 ♀;

Santo Domingo, 5 ♂, 4 ♀;

Patamba, 4 ♂, 2 ♀;

Natanzo, 1 ♂, 1 (♀);

"Quito," 1 [♀].

T. c. minimus.—

COLOMBIA:

Santa Marta, Mmca, 1 "♂" [= ♀] (type),

1 ♀, 2 [♀].

T. c. cumancensis.—

VENEZUELA:

Cumaná, Los Dos Ríos, 2 ♂ (incl. type);

Campos Alegre Valley, 1 ♀, 1 "♂" [= ♀];

Los Palmales, 1 ♂, 1 "♂" [= ♀];

Quebrada Seca, 1 "♂" [= ♀], 1 ♀;

La Tigra, 1 ♀, 1 "♀" [= ♂];

La Montaña del Guácharo, 1 "♀" [= ♂];

Cuchivano, 1 ♂;

San Antonio, 1 ♀;

Cristóbal Colón, 1 ♂.

"BRITISH GUIANA": 1 [♀].

Tyranniscus viridiflavus (Tschudi)

E(laenia) viridiflora TSCHUDI, 1844, Arch. Naturg., X (1), p. 274—Perú [coastal region given by Tschudi, 1846, Faun. Per., Aves, p. 160, but this almost certainly is an error]; Mus. Neuchâtel.

Tyranniscus frontalis BERLEPSCH AND STOLZMANN, 1894, Ibis, p. 390—Garita del Sol and San Emilio, Perú; a ♂ from Garita del Sol in Warsaw Mus. claimed as type by Stolzmann and Domaniewski, 1927, Ann. Zool. Mus. Pol. Hist. Nat., VI (2), p. 145; the San Emilio paratype is in the Amer. Mus. Nat. Hist.

It is only by Berlepsch and Hellmayr's study of Tschudi's type of *E. viridiflora* (1911, Jour. für Orn., LIII, p. 11) that it is possible to place "*frontalis*" in the same species with *viridiflavus*. Tschudi's description and the figure in the Fauna Peruana, Aves, Pl. IX, fig. 2, are unrecognizable and the supposed locality, the coastal region of Perú, is misleading.

A good series from central Perú shows relative uniformity in characters and size but there is still a noticeable amount of individual variation. The green of the back is usually fairly bright but two November specimens, perhaps a little more worn than the others (December, January, March, and May) are darker on the back and a little grayer on the chest. The pale yellowish frontal band usually is well marked and broad but some examples have it obscured by fine dusky tips and one specimen has it relatively narrow. In every case, however, there is a strong dusky spot in front of the eye and a broad yellow eye-ring. The cap is always definitely

gray, with dusky central spots on the feathers. The under parts are predominantly yellow, including the breast.

There is thus a definite, though not exceptionally broad, distinction between this species and *chrysops* and I should not be surprised to find this difference overcome by specimens from intermediate localities. For the present, however, the two groups may be kept specifically distinct with the realization that they are very closely related.

Peruvian records are from Garita del Sol and Paltaypampa.

SPECIMENS EXAMINED

T. viridiflavus.—

PERÚ:

San Emilio, 1 ♂ (paratype);

Pozuzo, 1 ♀;

Chanchamayo, 1 ♀;

Tulumayo, 2 ♂, 3 ♀;

Utcuyacu, 1 ♂, 1 ♀;

Vista Alegre, 4 ♂, 3 ♀;

Eneñas, 1 ♀;

San Juan, 1 ♂, 1 ♀.

Tyranniscus gracilipes gracilipes Sclater and Salvin

Tyranniscus gracilipes SCLATER AND SALVIN, 1867, P. Z. S. London, p. 981—Pebas, Perú; ♀; British Mus.

I have no Peruvian specimens from the northern part of the country but two examples from the lower Río Napo, south-eastern Ecuador, are not far from topotypical. One of these, a female, shows some remaining traces of immaturity but the other, a male, is fully adult. A moderate series from the upper Río Negro, Brazil, Mt. Duida, the Río Cassiquiare, and the upper Orinoco are in close agreement and obviously represent the same form. One bird from Mt. Roraima shows some approach toward *acer* of British Guiana, having a tendency toward a whitish tint on the upper throat, but it remains closer to *gracilipes*.

The Guianan *acer* is recognizable by the whitish throat, ashy-tinted chest, and paler yellow belly, but some examples of the two forms are very similar as is discussed again below.

¹ Specimens in Field Museum of Natural History, Chicago.

² Specimens in Academy of Natural Sciences of Philadelphia.

A series of specimens from southeastern Perú, northern Bolivia, and the upper Rio Madeira region of Brazil are recognizably distinct from true *gracilipes* and are described below.

A record from Chamicuro is difficult to assign without seeing the specimen in question but for purely geographical reasons is left with *gracilipes*.

***Tyranniscus gracilipes gilvus*, new subspecies**

TYPE from La Pampa, southeastern Perú. No. 146,237, American Museum of Natural History. Adult male collected October 10, 1916, by Harry Watkins; original No. 252.

DIAGNOSIS.—Similar to *T. g. gracilipes* of southeastern Ecuador, northeastern Perú, the upper Rio Negro, Brazil, and southern Venezuela, but differs by brighter green back, average paler gray cap, brighter yellow under parts, and somewhat less sharply defined wing-bars.

RANGE.—Southeastern Perú, northern Bolivia, and southwestern Brazil (upper Rio Madeira region).

DESCRIPTION OF TYPE.—Top of head Deep Neutral Gray with dusky centers on the feathers, giving a somewhat spotted appearance. Hind neck similar, tinged with Iron Gray; back Roman Green X Serpentine Green with the scapulars showing some dusky centers. Lores, superciliary region, and a subocular area indistinctly paler, hardly whitish; auriculars Buff Olive, yellower basally; throat Reed Yellow X Citron Yellow with chin paler but not whitish; sides of breast Yellowish Olive, the color lightening toward the center of the breast where there are some yellowish margins, not conspicuous; flanks like sides; belly broadly deep Citron Yellow but with some light olivaceous stripes on upper portion, merging the colors of breast and belly. Wings blackish; ninth (subexternal) to sixth primaries with greenish-yellow outer margins on basal half; secondaries with Reed Yellow outer margins, not reaching the bases of the feathers; tertiaries with margins paler and duller; lesser upper wing-coverts like the back; median series with a dull Primrose Yellow spot on outer margins at the tips of the feathers, not crossing to the inner web; greater series with outer margins narrowly Primrose Yellow except where concealed by the median coverts; under wing-coverts Barium Yellow; inner margins of remiges Marguerite Yellow. Tail brown, a little paler than the wings and with outer margins Dull Citrine. Bill (in dried skin) blackish; feet slaty blackish. Wing, 50.5 mm.; tail, 43; exposed culmen, 7.75; culmen from base, 10.5; tarsus, 15.25.

REMARKS.—Females like the males in color but smaller. Wing, 43–45 mm. (♂, 48–52.25); tail, 33.5–39 (♂, 40–45).

There is not a great deal of variation among the adults of this form and the series is easily distinguished from typical *gracilipes*. The lores and superciliary region are sometimes a little paler and more conspicuous than ordinarily and one female from the Rio Távora has a very narrow pale line crossing the forehead, suggesting possible affinity with *T. viridiflavus*, certain examples of which are hardly better marked in that respect though all of them have much more pronounced superciliaries, a rather strong dusky spot in front of the eye, a much broader and more conspicuous eyering, and longer wings and tail. Whether these differences ought to be considered as specific is questionable, but I have yet seen no specimen that is not instantly determinable as either one or the other of these forms. The same holds true with *viridiflavus* and *chrysops*. Material from intervening regions may, sometime, show the intergradation of these three groups.

The case is different with regard to *gracilipes* and *acer*. While typical examples of these two forms are easily distinguishable, some examples of *acer* have a definite tinge of yellow on the throat and opposite extremes of *gracilipes* have their normal coloration reduced to near the same tints. Both forms have been recorded from Roraima but it is not impossible that there has been some confusion due to intergradation at that point. Most of the specimens recorded from Roraima have been referred to *gracilipes* and only one to *acer*. Our single specimen from Roraima is somewhat intermediate though closer to *gracilipes* but a skin from Carimang River and one from Potaro Landing, British Guiana, are both *acer*.

More puzzling are three specimens from southeastern Perú which show a decided approach toward *acer* although it is difficult to see how they could be subspecific hybrids in view of the far distant range of *acer*. These three birds have the yellow pigment reduced throughout, giving the back a dull grayish olive tone, the throat a pale yellowish, almost whitish, tint, the breast a somewhat decided grayish color with slight yellowish flammulations, and the belly a Primrose Yellow hue while the

wing-bars are duller and more greenish yellow than even most *acer*. There is a great similarity between these specimens and the brightest examples of *acer*. One of the three birds, a male, is marked as having the testes much enlarged but all three have a certain immaturity of appearance, especially in the texture of the plumage. I believe they are but imperfectly colored examples of *gilvus* with which they agree in dimensions, pattern, and, in one case, exact locality. They do not suggest any other species.

However, I believe *acer* should be placed as a subspecies of *gracilipes* and have so considered it.

There are no previous records from Perú that are certainly assignable to *gilvus*.

SPECIMENS EXAMINED

T. g. gracilipes.—

ECUADOR:

mouth of Río Curaray, 1 ♂, 1 ♀.

BRAZIL:

Rio Negro, Yucabí, 2 ♂;
Camanaos, 1 ♂;
Cucuh, 1 ♂;
Rio Uaupés, Ianarete, 2 ♂;
Tahuapunto, 2 ♂.

VENEZUELA:

Río Cassiquiare, Solano, 1 ♂, 2 ♀, 1 (?);
Buena Vista, 2 ♂, 1 ♀, 1 (?);
Mt. Duida, Caño Seco, 1 ♀;
Boca de Sina, 1 ♀;
(western) foot of Duida, 1 ♂, 1 ♀;
Río Orinoco, Maipures, 1 ♀;
Mt. Roraima, 1 ♀.

T. g. acer.—

BRITISH GULANA:

Potaro Landing, 1 ♂;
Carimang River, 1 ♂.

DUTCH GULANA:

near Paramaribo, 1 ♂, 1 ♀;
"Interior," 1 (?).

BRAZIL:

Faro, 2 ♂, 1 ♀;
Rio Negro, Manaos, 2 ♂, 2 ♀;
Igarapé Cacao Pereira, 1 ♀;
Pará, Belem, 1 ♂;
Rio Tocantins, Arumatheua, 1 ♀;
Mocajuba, 4 ♂, 2 ♀;
Baão, 3 ♂, 2 ♀;
Rio Xingú, Tapará, 2 ♂, 1 ♀,
Rio Tapajoz, Santarem, 1 (?);
Aramanay, 1 ♂, 1 ♀;
Piquiatuba, 1 ♀;
Igarapé Brabo, 1 ♂;
Igarapé Amorin, 1 (?).

T. g. gilvus.—

PERU:

La Pampa, 1 ♂ (type), 1 ♂¹, 2 ♀;
Río Távara, 1 ♀;
Huacamayo, 2 ♂¹ (one abnormally grayish);
Candamo, 2 ♂ (abnormally grayish).

BOLIVIA:

Río Beni, Salinas, 1 [♀];
Río Chaparé, Todos Santos, 2 ♂¹;
Río Mapurí, Huanay, 1 ♂¹.

BRAZIL:

Río Preto, Santa Isabel, 1 ♂, 1 ♀.

Tyranniscus cinereicapillus (Cabanis)

Phyllosmyias cinereicapilla CABANIS, 1873,
Jour. für Orn., XXI, p. 67—Monterico, Dept.
Ayacucho, Perú; ♀; type formerly in Warsaw
Mus., now lost.

A specimen in the American Museum from Chanchamayo was compared with the type of this form by Hellmayr and found to agree closely except for a certain paler coloration of the type probably due, according to Hellmayr, to the fact that the type was originally preserved in spirits. The Academy of Natural Sciences of Philadelphia has two males and a female, kindly lent to me by Mr. Bond of that institution, which agree in all essential respects with the American Museum specimen. Most surprising has been the discovery of still another example in the American Museum collections from the upper Río Suno, northeastern Ecuador, a locality far from the suspected range of the form.

With this material it is now possible to give the essential diagnostic characters of *cinereicapillus*, some of which appear to have been overlooked, and to remove it from the *gracilipes* group where, I am sure, it is out of place.

There is a superficial resemblance to *g. gracilipes* and *g. gilvus*. The spotted gray crown is very similar in both groups but in *cinereicapillus* the gray averages a little lighter and duller with some definite olive green margins on the back of the head. The back is a little lighter and clearer green than even in *gilvus*. The sides of the head have even less suggestion of pale markings on the lores and around the eye, being relatively uniform grayish. The throat is definitely whitish or pale grayish, with a very slight yellowish tinge. The breast and

¹ Specimens in Academy of Natural Sciences of Philadelphia.

belly are very similar to those of *gilvus* but the flanks are lighter and not so olivaceous as in most *gracilipes* or *gilvus*. The wing-markings are very nearly the same in pattern as those of the *gracilipes* group except that, whereas in the *gracilipes* group the yellowish border of the inner tertial is narrow and sharply defined, in *cinereicapillus* it is broader and has its inner border somewhat more diffuse. The wing-bars are noticeably paler yellow than in the *gracilipes* group. The bill has a curious purplish or reddish tone, sometimes obscured on the darker maxilla but quite pronounced on the mandible. The feet, also, show a reddish tinge in the dried skins. In addition, the bill is flatter and with a somewhat broader outline and rather less sharply ridged culmen than the other species. There is some resemblance to the bill of certain species of *Phyllomyias*, where the species was placed by its describer, but the general characteristics are those of *Tyranniscus*, including the peculiar wing-pattern. This pattern, of probable taxonomic significance, comprises the pale basido-lateral margins of four or five subexternal primaries and uniform black

margins of the external and the four or five inner ones, and in the narrow yellowish margining of the median and greater wing-coverts. This combination is found in a number of species of *Tyranniscus* that are fairly closely related and *cinereicapillus* presumably belongs with them.

T. cinereicapillus agrees in size with *viridiflavus* which occurs in the same region though they differ from each other otherwise more than either does from *gracilipes*. Since *viridiflavus* is the more likely contender for a place in the *gracilipes* group, I consider *cinereicapillus* to be certainly specifically distinct.

Aside from the type and the specimens listed herewith, there are no records of this species.

SPECIMENS EXAMINED

T. cinereicapillus.—

PERÚ:

Chanchamayo, 1 ♀;

San Juan, Chanchamayo, 2 ♂¹; 2 ♀¹.

ECUADOR:

Rio Suno, above Avila, 1 ♂.

¹Specimens in Academy of Natural Sciences of Philadelphia.

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A REVISION OF *COELACANTHUS NEWARKI* AND NOTES ON THE EVOLUTION OF THE GIRDLES AND BASAL PLATES OF THE MEDIAN FINS IN THE COELACANTHINI

By BOBB SCHAEFFER¹

INTRODUCTION

The existence of coelacanth fishes in the Upper Triassic of North America has long been known from the description by Newberry (1878, 1888) of the very poorly preserved *Diplurus longicaudatus*. Since then, Lambe (1916) has described *Coelacanthus banffensis* from a single fin and more recently Bryant (1934) has reported *Coelacanthus newarki* from the Newark Series. From a new locality much more abundant material of a form that is exceedingly close to *C. newarki* has become available; and in view of the scarcity of coelacanth remains from the Triassic of North America, it is desirable to report this material in some detail.

It has been pointed out by Stensiö (1921) and Moy-Thomas (1937) that a great number of the coelacanths referred to the genus *Coelacanthus* possess characters that are quite distinct from those of the genotype, which is the Permian *Coelacanthus granulosus* of Agassiz (1839). In view of this fact, and for reasons to be mentioned later, it seems advisable to establish a new genus for the reception of the species from the Upper Triassic of Pennsylvania, described as *Coelacanthus newarki* by Bryant, and also for the material to be described in this paper, which is referred to the same genus and species.

The name *Osteopleurus* (Gr. osteon, bone, and Gr. pleuron, rib) is herewith proposed for this genus in allusion to the long, ossified ribs. It will tentatively contain just one species, *newarki*. The type is Prin. Univ. Pal. Mus. No. 13695.

The author is indebted to Dr. G. M. Kay of the Department of Geology, Columbia

University, for the discovery and presentation of the first specimens from this latter site, to Mr. V. E. Shainin for the presentation of the very fine specimens in his possession, and particularly to Professor A. W. Pollister of the Department of Zoölogy for permission to study his private collection and for much helpful advice. He also wishes to thank Dr. G. L. Jepsen for permission to study the type specimen, Professor W. K. Gregory and Mr. H. C. Raven for critically reading the manuscript and finally Dr. A. J. Ramsay for his assistance with certain of the photographs. All the specimens collected in the Granton Quarry have been presented to The American Museum of Natural History and catalogued as A.M.N.H. No. 15222.

OSTEOPLEURUS, NEW GENUS

GENOTYPE.—*Coelacanthus newarki* Bryant.

DIAGNOSIS.—Long, ossified, pleural ribs. Pelvic fin midway between first and second dorsal fins. Plates of pelvic girdle quadrilateral in shape. Basal plate of anal fin bifurcated. Basal plate of first dorsal, triangular. Basal plate of second dorsal, deeply bifurcated. Scales possessing about five prominent parallel ridges.

HORIZONS AND LOCALITIES

The Pennsylvania material (one complete specimen and several fragments) was collected by Dr. Jepsen in the Upper Triassic shales of the Newark Series in an exposure of the Lockatong formation, near the town of North Wales. The New Jersey specimens were found in the Upper Triassic black shales of the Stockton formation of the Newark Series in the Granton Quarry at North Bergen, New Jersey. The character of the sediments and the presence of

¹ Department of Zoölogy, Columbia University.

the phyllopod *Estheria ovata* Lea indicate that both formations are quite probably fresh water and less likely brackish water deposits.

MEASUREMENTS

There are no observable qualitative characters which can be used to separate the forms from the Lockatong and the Stockton. There are, however, quantitative differences which at first were considered to be of specific significance. An attempt was made to use quantitative methods outlined by Simpson and Roe (1939) for comparing small samples and single specimens in an effort to determine whether we are dealing with a single species or two separate species. This was not successful, however, since nothing is known concerning relative ontogenetic growth in coelacanths in general, and since the number of measurable specimens of *Osteopleurus* is very small. As Dr. Simpson pointed out, it is impossible to determine in this case whether the quantitative differences are specific differences or merely different stages in the growth of a single species. Therefore, until more well-preserved material is obtained, all of the specimens are referred to the one species, *newarki*.

MEASUREMENTS IN MILLIMETERS

	New Jersey Speci- mens	Pennsyl- vania Speci- mens (approx.)
Body length (minus supplementary caudal)	110	71
Head length	30	19
Length post. border of head to ant. border of caudal	45	26
Length first caudal	35	26
Length first plus second caudal	45	?
Fin locations, mm. from anterior end to:		
First dorsal	35-40	22
Second dorsal	62	36
Pelvic	45	25-26
Anal	68	40
Caudal	80	45
Body depth at ant. end of first dorsal (approx.)	24	15

SQUAMATION

Each scale appears to be an elongated oval. The exposed portion possesses about

five prominent longitudinal ridges, the middle one being the longest and largest. There are also fine striae which converge in the covered portion. Annular rings are present which tend to break the continuity of the striae. The details of ornamentation are well preserved in the scale illustrated in Fig. 2,A.

SKULL

Due to crushing it is impossible to make out the detailed structure of the skull in any of the specimens. Some features of importance can be determined in one of the specimens from the Stockton (Fig. 1,A), and, also, from numerous isolated plates. The opercular is a large bone, as it is in most coelacanths. An isolated example shows that it is oval in outline and lacks ornamentation. The outline of the post-orbital cannot be determined in the preserved skull. An isolated plate (Fig. 4,B), which has a different shape than the opercular, has been tentatively identified as the postorbital, although it may be relatively too large to be this bone. The lack of a lateral line canal would seem to indicate that the medial surface is exposed. The postorbital lateral line canal is, however, very prominent in the preserved skull. That the squamosal, opercular, preopercular, and subopercular are missing from this skull is indicated by the presence of a depressed region (Fig. 1,A,x) behind the orbit. Furthermore, the squamosal branch of the postorbital lateral line canal is not evident.

The angular bone can be readily identified, as the mandibular branch of the lateral line runs over it. The dentary, splenial, and coronoid are not distinct. The gular plates possess the long, oval shape characteristic of the coelacanthids. They are ornamented with fine ridges which follow the outline of the bone. One end has a wide, shallow groove which tapers to a point in the middle of the plate. They are 11 mm. in length and 2.7 mm. in width (Fig. 2,C).

The suture between the frontals and intertemporals is very evident, the bones having been abnormally separated during

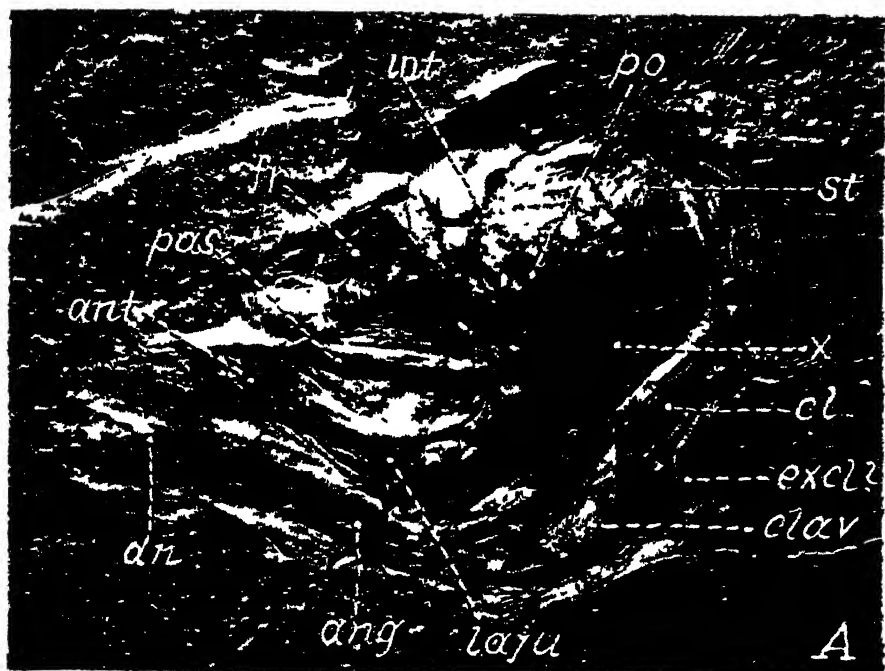


Fig. 1. *Osteopleurus newarki*.

A. Lateral view of skull. $\times 2.8$. ang., angular; ant., antorbital; clav., clavicle; cl., cleithrum; dn., dentary; excl., extracleithrum; fr., frontal; int., intertemporal; laju., lacrimo-jugal; pas., parasphenoid; po., postorbital; st., supratemporal; x., opercular region.

B. Lateral view of almost complete specimen showing position of all the fins, scale imprints, and ossified ribs. $\times 1.1$.

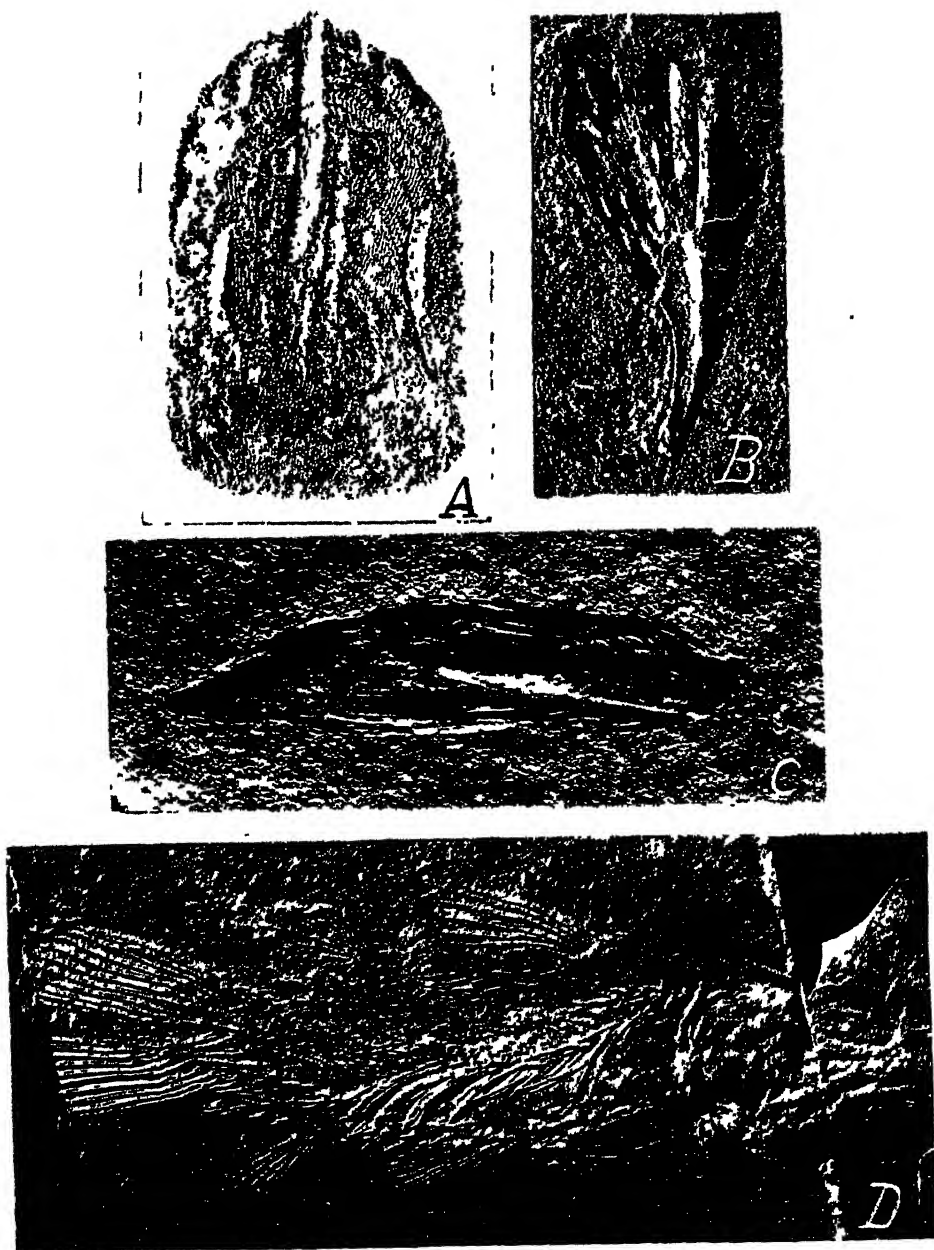


Fig. 2. *Osteopleurus newarki*.

- A. Isolated scale showing details of sculpturing. $\times 18.0$.
- B. Unidentified plate. $\times 9.6$.
- C. Gular plate. $\times 7.4$.
- D. Lateral view of a second almost complete specimen showing well-preserved neural arches. $\times 1.4$.

preservation. The supratemporal and extrascapulars cannot be distinguished from the intertemporal, although the supratemporal is undoubtedly present as a poorly defined plate lying just dorsal to the opercular region. What appears to be an antorbital is present as a small triangular bone on the anterior rim of the orbit. The postrostrals and premaxillary are crushed and their outlines cannot be determined. The circumorbital plates have not been preserved. The lacrimojugal characteristically frames the ventral rim of the orbit.

A bar of bone running lengthwise through the orbit may be the somewhat dorsally displaced parasphenoid. It resembles that part of the bone between the more posterior expanded portion and the ethmoid ossification, as figured by Moy-Thomas (1937) for *Rhabdoderma*.

The ossified part of the neurocranium (Fig. 4,C) is poorly preserved in dorsal aspect on one of the slabs in the Princeton collection (P.U.P.M. No. 13826). The parasphenoid has its edges upturned to a greater degree than in *Wimania*. On each side of the channel thus formed a bony wing projects sideways, as in the *Undina* parasphenoid (Aldinger, 1930). Very fragmentary bits of bone anterior to the parasphenoid have been identified as the ethmoid ossifications. The location of the basisphenoid, prootic, and basioccipital is indicated, but it is impossible to make out any of the structural details. There are several examples of a well-preserved isolated plate of constant shape which cannot be positively identified (Fig. 2,B). It is possibly a part of the ossified neurocranium, or even of the pterygoid complex.

PAIRED FINS AND GIRDLES

The pectoral fin is barely indicated on Mr. Shainin's specimen, lying on what may be the remains of the ossified swim bladder (Fig. 2,D). One specimen has a well-preserved pectoral girdle (Fig. 1,A). The cleithrum is apparently quite similar to that found in *Rhabdoderma*. Externally, there is a ridge which runs from the upper posterior border to the lower anterior border. A curved clavicle is indicated

which meets the ventral border of the cleithrum.

A pelvic fin is preserved in place in two of the specimens, but the pelvic girdle is covered with a layer of matrix which cannot be removed. It is preserved in the type, being well ossified, quadrilateral in outline, and with concave margins. The fin has about twelve lepidotrichia and is relatively further behind the pectoral girdle than the pelvic fin of *Coelacanthus granulatus*.

UNPAIRED FINS

The anterior dorsal fin including the basal plate is well preserved in several specimens (Fig. 3,A). This plate has a more or less triangular shape, with the apex pointed anteriorly. The lepidotrichia, about nine in number, are attached directly to the plate, the proximal ends being forked to fit over the plate. The former are grooved and flattened laterally and are not broken up into segments, except at their distal ends.

The basal plate of the posterior dorsal fin is preserved in the complete Pennsylvania specimen. As Bryant states, the plate is bifurcated. The lower process, however, is about the same length as the upper, as can be seen in the example figured in Pl. VIII, fig. 1, of Bryant's paper. The fin contains about twelve lepidotrichia.

The basal plate of the anal fin (Fig. 9,E) is also only known from the type specimen. It is deeply bifurcated, the forks being more slender than those on the basal plate of the posterior dorsal. The process with which the fin rays articulated is quite narrow but somewhat expanded posteriorly.

Both the epichordal lobe and the hypochordal lobe of the caudal fin contain about ten to twelve lepidotrichia. The supplementary caudal fin is beautifully preserved in negative in one of the New Jersey specimens (Fig. 3,B). It is relatively longer than the one found in *Undina* and consists of dermal rays in the usual tuft.

AXIAL SKELETON

The neural arches are robust forked structures with fairly long, spinous processes which are apparently rather well ossified (Fig. 2,D). There are about thirty

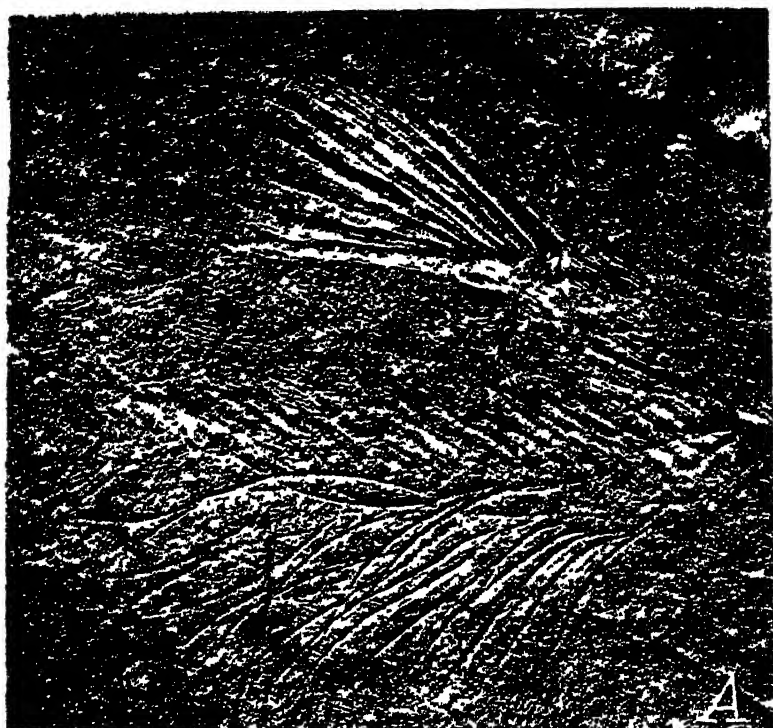


Fig. 3. *Osteopleurus newarki*.

- A. Trunk region showing first dorsal fin, with its basal plate, neural arches, and ossified ribs. $\times 2.9$.
 B. Specimen showing caudal fin and well-preserved supplementary caudal fin. $\times 23$.

pairs of long, ossified pleural (subperitoneal) ribs (Fig. 2,D and Fig. 3,A). This is an important character which, above all others, separates *Osteopleurus* from the genotype of the genus *Coelacanthus*, which has very short, pleural ribs. Haemal arches are evident posterior to the last rib (Fig. 2,D).

With regard to the Upper Triassic coelacanth from North America, *Coelacanthus banffensis* (Lambe, 1916), from Alberta, is, as Moy-Thomas points out, far too fragmentary for generic determination.

Diplurus longicaudatus (Newberry, 1878) from the Brunswick Formation of the Upper Triassic of New Jersey is quite distinct from *Osteopleurus*. It reaches a length of three feet and lacks ossified ribs. The

scales have a great number of fine longitudinal ridges. The only observable resemblance between the two is the triangular shape of the basal plate of the first dorsal, which, as will be shown, is a character common to most members of the order.

By establishing the new genus *Osteopleurus* for the identifiable remains of coelacanthus other than those of *Diplurus* from the Triassic of Pennsylvania and New Jersey, it is hoped that a further contribution has been made toward a more natural classification of the Coelacanthini. The evidence indicates that *Osteopleurus* is probably most closely related to *Coelacanthus*, although, as pointed out above, the pelvic plates have a very different shape. Until better preserved skull material is found, it is unsafe to speculate further.

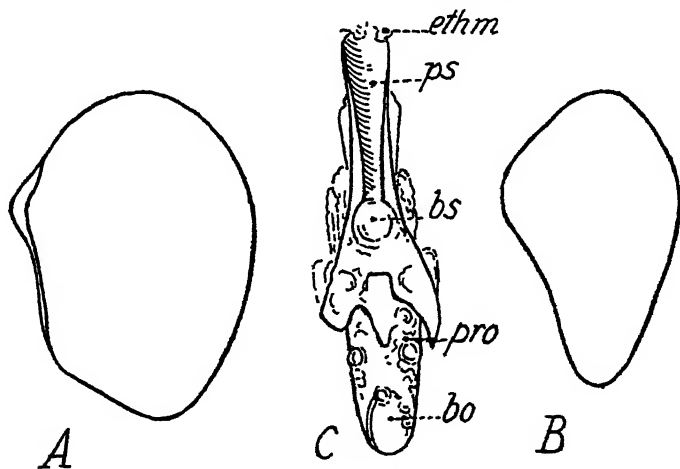


Fig. 4. *Osteopleurus newarki*.

- A. Outline of opercular plate. $\times 3.5$.
 B. Outline of plate tentatively identified as postorbital. $\times 3.8$.
 C. Dorsal view of neurocranium. $\times 8.1$. eth., ethmoid; ps., parasphenoid; bs., basisphenoid; pro., prootic; bo., basioccipital.

THE EVOLUTION OF THE GIRDLES AND BASAL PLATES OF THE MEDIAN FINS IN THE COELACANTHINI

In an attempt to determine the possible affinities of *Osteopleurus* a comparative study of the paired and unpaired fin supports has been undertaken. It is well known that in most respects the coelacanthus are a very homogeneous and rather conservative order. Stensió has pointed out

(1932, p. 46), however, that the group shows a much greater range of variation than formerly suspected and that it is possible to distinguish several natural groups of genera. There are some striking variations in the pelvis and in the basal plates of several of the median fins. These varia-

tions must be considered along with the skull in dividing the Coelacanthini (Acinistia) into smaller categories. Up to the present time, no attempt has been made to subdivide the order or to construct at least a tentative phylogeny. Such an attempt is made in this paper.

Moy-Thomas has suggested (1937) that it may be fused with the cleithrum in many cases, i.e., *Rhabdoderma*.

The supracleithrum is evidently loosely united by ligaments to the cleithrum in all but a few genera, such as *Coelacanthus* and possibly *Osteopleurus*, in which it appears

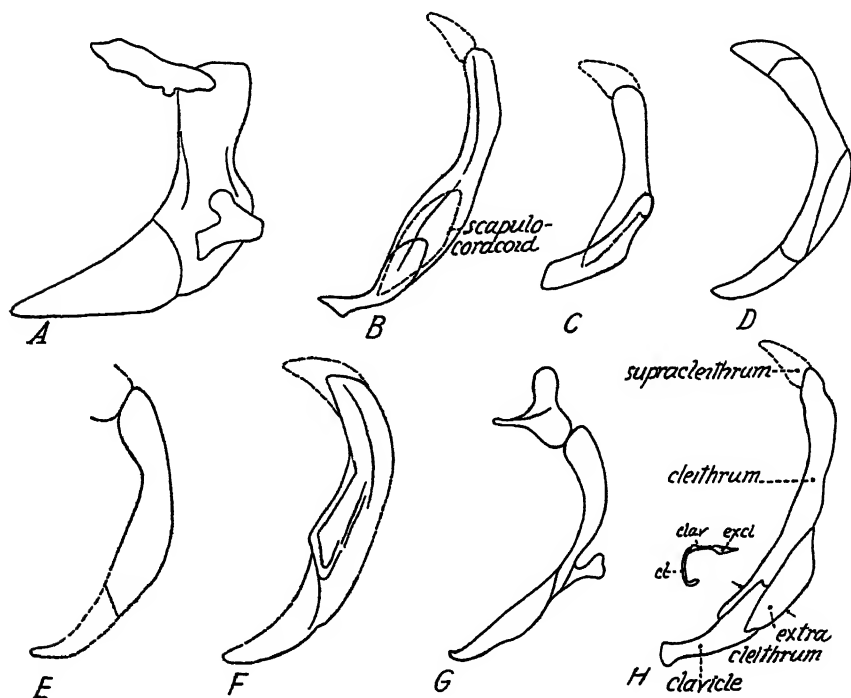


Fig. 5. Series of pectoral girdles. Scales various.

- A. *Eusthenopteron foordi*. Upper Devonian. Medial view (after Bryant).
- B. *Diplocercides kayseri*. Upper Devonian. Lateral view (after Stensiö).
- C. *Rhabdoderma elegans*. Upper Carboniferous (composite, after Huxley and Moy-Thomas).
- D. *Coelacanthus granulatus*. Permian. Lateral view (after Moy-Thomas and Westoll).
- E. *Laugia groenlandica*. Lower Triassic (after Stensiö).
- F. *Osteopleurus newarki*. Upper Triassic (original).
- G. *Macropoma speciosum*. Cretaceous (after Reis).
- H. *Latimeria chalumnae*. Recent. Lateral view and cross-section at level of arrows (after Smith).

THE PECTORAL GIRDLE

The pectoral girdle (Fig. 5) in all coelacanth consists of the following dermal elements: a somewhat triangular supracleithrum, a dominant cleithrum, and a clavicle which is never as long or as wide as the cleithrum. The endoskeletal portion of the girdle is but rarely distinguishable.

to be suturally united. It is interesting to note in this connection that there is considerable variation in the intimacy of the union between the supracleithrum and the cleithrum in the teleosts.

The cleithrum is quite constant in shape, the variations being of minor importance. It is, in general, the longest bone of the

girdle and is in most cases rather narrow. It is relatively much narrower than the same bone in the rhipidistians. In *Latimeria* (Smith, 1940) the cleithrum is curved about its long axis as can be seen in the cross-section in Fig. 5,H. This is apparently not a general feature, for in *Rhabdoderma* it is a strongly ridged but essentially a flat plate.

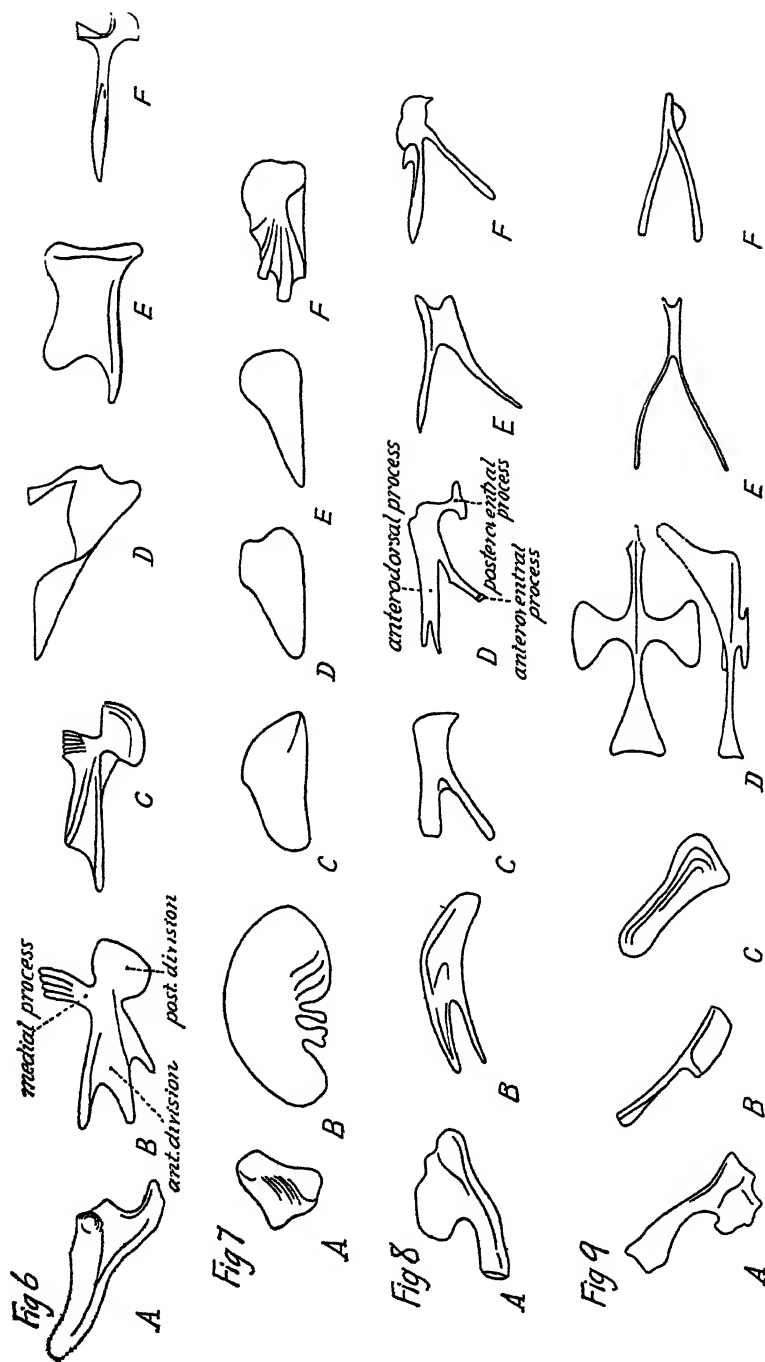
The coelacanth clavicle has its greatest extent in the same vertical axis with the cleithrum. It lacks the prominent horizontal portion which is present in the rhipidistian clavicle. The clavicle of the Upper Devonian *Diplocercides* does possess a fairly wide horizontal ramus, approaching the condition in *Eusthenopteron*. In all genera the clavicles meet in the midventral line. In *Latimeria* each clavicle has a distinct facet for articulation with its fellow. There is no evidence of the presence of an interclavicle as recently described by Gross (1936) in certain rhipidistians.

One of the most interesting features of the pectoral girdle is the presence of a dermal bone apparently not found in any other vertebrate. This bone, named by Moy-Thomas the extracleithrum, has so far been observed only in *Coelacanthus granulatus* (Fig. 5,D) and in *Latimeria chalumnae* (Fig. 5,H), although it may have been present in *Osteopleurus*. It is located on the lateral surface of the girdle behind the cleithrum, contacting the clavicle ventrally. The phylogenetic history of the extracleithrum is at present unknown. It does seem odd that it should appear as a neomorph in only a few genera. Moy-Thomas (1935) does not believe it to be homologous with the postcleithrum of actinopterygians since it is ventral to the endoskeletal portion of the girdle. In any case the very distant affinities of the coelacanth and teleosts seem to preclude any possibility of determining its origin and homologies in that manner. It appears extremely unlikely that the extracleithrum is a new element in the coelacanth. Very probably it is indistinguishably fused with the cleithrum in most cross-sections at an early stage in ontogeny. In *Latimeria*, it is situated superficially to the cleithrum and the

clavicle and is very slightly overlapped by them on its anterior margin.

The earliest coelacanthid pectoral girdle known, that of *Diplocercides*, possesses a separately ossified scapulo-coracoid element of relatively large size. As mentioned above, the endoskeletal portion of the girdle is not as independent of the dermal as it is in the rhipidistians. In *Diplocercides*, it consists of a flat, lenticular plate very intimately associated with the cleithrum and clavicle. Besides the suggestion of Moy-Thomas that it may be fused with the cleithrum, the possibility that it was often but poorly ossified must be considered. In *Undina* and *Macropoma*, the endoskeleton has a posterior projection which extends beyond the cleithrum. This process is quite characteristic of these Mesozoic genera. To it was attached the skeleton of the pectoral fin. In no case is it possible to distinguish the scapular element from the coracoid, as they are completely co-ossified.

There is considerable variation in the location of the scapulo-coracoid plate, and hence, in the pectoral fin in relation to the cleithrum and the pectoral girdle as a whole. In *Diplocercides* the plate is located on the lower extremity of the cleithrum, even overlapping the clavicle to a considerable degree. In nearly all other coelacanth the endoskeleton has apparently migrated, at least relatively, dorsalward to the middle of the cleithrum. In *Macropoma* and *Undina*, the same positional result is obtained by a relative increase in the length of the clavicle. It would appear that the various positions of the pectoral fin were specializations associated with the different modes of living in the Coelacanthini. For instance, the pectoral fin of *Laugia* could only have been used for maneuvering movements while swimming, while that of *Diplocercides*, like *Eusthenopteron*, was probably also used for propelling the body over the sea floor. Unfortunately, the endoskeletal girdle of *Latimeria* was not recovered, but Smith (1940) is of the opinion that it is situated just inside the dorsal apex of the extracleithrum, as in *Coelacanthus granulatus*, or at about the



middle of the cleithrum. The pectoral fin, however, has a rather long, fleshy portion, thus carrying the fin well down below the ventral surface of the body. This suggests that it can be used for pulling the body over the ocean floor.

THE PELVIC GIRDLE

The variation in the shape of the pelvic plates results in a natural division into three types represented by the plates of *Rhabdoderma*, *Laugia*, and *Osteopleurus* (Fig. 6). Unfortunately the pelvis has been described or preserved in but few of the known genera and the differences between these known types are extreme enough to indicate that the range of variation must have been rather great. Although the pelvis is unknown in the Upper Devonian forms, it is well preserved in the Carboniferous *Rhabdoderma*. This probably represents a very close approach to the primitive type. The resemblance to the pelvis of *Eusthenopteron* is not too great but is close enough to indicate a derivation from the rhipidistian type. Through the kindness of Professor Gregory and Mr. Raven I am permitted to include a figure of the second known specimen of a pelvic plate of *Eusthenopteron* which will be described by them in detail at a subsequent time. It suffices here to note that this plate does not resemble very closely the one figured by Goodrich (1901) but does agree more closely with the *Rhabdoderma* type.

The *Rhabdoderma* type of pelvic plate is also found in *Coelacanthus granulatus*, *Undina*, *Macropoma*, and *Wimania*. The part of the plate showing the greatest amount of variation in this group is the medial process. This process may (*Rhabdoderma*) or may not (*Undina*) possess a denticulated medial border. It varies in size from little more than a serrated region on the medial border between the anterior and posterior divisions in *Wimania* (Stensiö, 1921, Pl. VIII, fig. 7) to a very prominent process in *Rhabdoderma*. This process articulated with its counterpart of the opposite side to produce a girdle which in transverse section was either perfectly

horizontal, as in the Rhipidistians, or slightly V-shaped. In such forms as *Wimania* and *Coelacanthus* the space between the adjoining pelvic plates would be a mere slit, while in *Rhabdoderma* and *Undina* it would be relatively quite large.

The anterior and posterior divisions (so-called by Stensiö, 1932) were expanded to various degrees for the attachment of the body and fin musculature. The proximal radial(s) of the pelvic fin articulated with the posteroventral region of the posterior division.

The pelvis of *Laugia* is situated so far forward that it evidently made a ligamentous connection with the clavicle of the pectoral girdle. This very percomorph-like position plus the great size of the pelvic fins were probably responsible for the very different shape of the plates of this girdle. In spite of the specializations, it is possible to recognize homologous parts in the pelvic plates of *Laugia* and *Rhabdoderma*. A plate of the former has triangular anterior and posterior divisions with a prominent but not denticulated medial process springing from the latter. As in the percomorphs, the pelvic girdle is hence not only anchored by the hypaxial musculature but also by attachment to the pectoral girdle. This condition undoubtedly evolved along with the enlargement of the pelvic fin which, incidentally, extends posteriorly almost to the base of the anal fin. Such a large fin would offer great resistance to the water during movement, necessitating the coincidental development of such a bracing mechanism. A pelvic plate of *Laugia* is further specialized in having the anterior division twisted medially and the medial and lateral borders of the posterior division turned more or less dorsally, thus offering the most advantageous positions for the attachment of the fin and body muscles.

Stensiö considers the pelvis of *Laugia* to be suggestive of the *Rhabdoderma* type, particularly of *Rhabdoderma elegans*. It was probably derived from a form with a rather well-developed medial process.

The pelvis of the *Osteopleurus* is at present quite baffling. A study of Bryant's

original material has not revealed with certainty which is the lateral and which the medial borders of the plates. Until this point can be definitely settled it is unwise to make detailed comparisons. In any event, the pelvic plates are very unlike anything previously described and if found alone would certainly not be considered as coelacanthid. A plate is quadrilateral in outline, rather than pentagonal as Bryant states, with a rather short anterior projection. The border of each side is slightly concave.

BASAL PLATE OF THE FIRST DORSAL FIN

In most genera the basal plate of the first dorsal fin (Fig. 7) is triangular with the apex directed forward. One observed exception to this is found in *Rhabdoderma*, in which the plate is oval or kidney-shaped. The ventral border is notched in some species of this genus for articulation with the neural spines. The other exception is found in *Scleracanthus* in which the plate, while being essentially triangular, is slightly forked at its anterior end. In the rhipidistians, the basal plate of this fin is simply a rod with no anteroposterior expansion (Moy-Thomas, 1939, Fig. 22, A). A single radial is situated between this plate and the lepidotrichia of the fin. In the coelacanth, on the other hand, the lepidotrichia articulate directly with the dorsal border of the fin.

BASAL PLATE OF THE SECOND DORSAL FIN

The basal plate of the second dorsal fin (Fig. 8) is without exception a bifurcated structure. The open part of the V is always directed forward. In *Eusthenopteron* the anterodorsal process is very short and rounded, while the anteroventral process is much longer and quite robust. Such a plate could very well be the structural ancestor of the same plate in the coelacanth.

In the latter, the two processes are more nearly the same size. The anterodorsal process is in all cases on the same longitudinal axis with the posterior expanded portion of the plate, while the anteroventral process meets the posterior division at an angle of about thirty-five degrees. The posterior portion reaches its greatest extent in *Rhabdoderma*, in which the anterior processes are relatively quite short. In *Osteopleurus*, on the other hand, the processes are relatively long and narrow and the posterior division is reduced. *Laugia* has a well-developed posteroventral process. This extension is indicated in *Coelacanthus granulatus*, *Undina penicillata*, and in *Mawsonia minor* (Woodward, 1908). The basal plate of the second dorsal fin is certainly one of the diagnostic structures, along with the caudal fin, of the postcranial skeleton.

BASAL PLATE OF THE ANAL FIN

The variation in the shape of this plate (Fig. 9) is, indeed, very extreme. In *Rhabdoderma* it resembles that of *Eusthenopteron* rather closely and for that reason the former may approach the primitive type. The simple quadrilateral plate of *Coelacanthus granulatus* may represent the posterior expanded portion of the *Rhabdoderma* type. In *Osteopleurus*, *Undina*, and *Macropoma*, the plate is deeply bifurcated like the basal plate of the second dorsal fin. This type must have arisen by the development of an anteroventral process from the posterior expanded division. The basal plate of this fin in *Laugia* is so utterly unlike any of the others that its origin is not ascertainable. In the ventral view, it is cross-shaped. A large median keel projects dorsally at right angles to the horizontal portion. These various extensions certainly anchored the plate firmly in the ventral musculature, and their development must have been associated with some sort of torsion acting on the plate during fin movement.

A PHYLOGENY OF THE COELACANTHINI

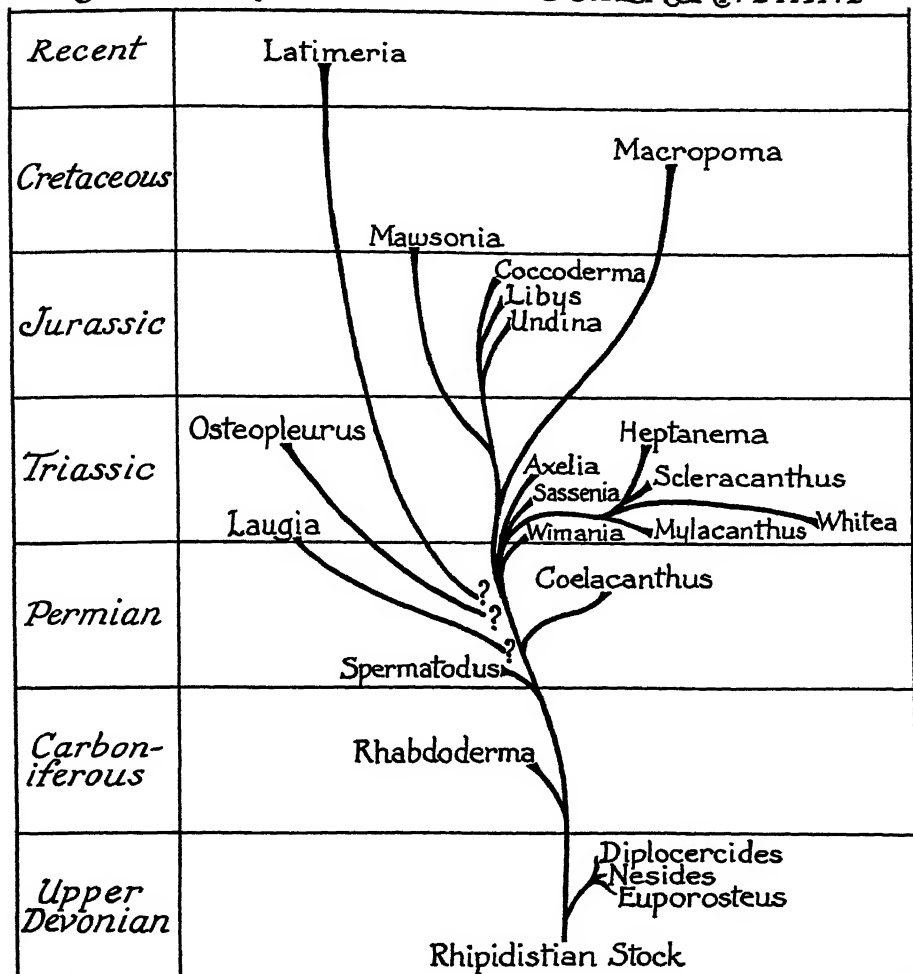


Figure 10.

CLASSIFICATION AND PHYLOGENY

The accompanying phylogeny of the Coelacanthini (Fig. 10) is simply a very tentative attempt to indicate the relationships between certain of the better known genera. As Stensiö (1932) has pointed out, certain of the genera do fall together in natural groups, possibly into families or superfamilies. The characters which establish the coelacanth as a separate order

within the Crossopterygii have been recently summarized by Moy-Thomas (1939) and will only be incidentally mentioned here.

The Upper Devonian forms from Germany, *Diplocercides*, *Nesides*, and *Euporo-*
steus, are certainly a natural and primitive group. The neurocranium is ossified in two separate parts and a true basipterygoid

process is present on the basisphenoid. Both of these characters are present in the rhipidistians. Furthermore, the presence of a horizontal limb on the clavicle is a primitive rhipidistian feature not found in later coelacanth.

Moy-Thomas (1937) has done a great service by revising the Carboniferous and Permian coelacanth of the British Isles and thus eliminating a vast amount of synonymy. Although all the Carboniferous forms have been referred to the genus *Rhabdoderma*, Moy-Thomas himself admits that in the future this genus may have to be subdivided into several genera. This group may then constitute a family. *Rhabdoderma* illustrates a further step in the evolution of the order in the employment of the antotic process (extending laterally from the dorsal border of the basisphenoid) as the articular contact of the neurocranium with the metapterygoid. There is some reduction in the size of the basipterygoid process. The neurocranium is subdivided into a series of ossifications instead of two major ones. All later coelacanth have a similarly constructed neurocranium. The pelvis of *Rhabdoderma* is the most ancient known and appears to represent the primitive coelacanthid type, showing very distinct but derivable differences from rhipidistians. The same is true for the endoskeletal supports of the other fins, paired and unpaired (except possibly the basal plate of the first dorsal).

Now that the genus *Coelacanthus* has been properly defined (Moy-Thomas and Westoll, 1935), it may, in the future, form the nucleus of a Permian family. It is further evolved from the *Rhabdoderma* stage by the loss of the basipterygoid process and the presence of only the antotic process. This condition holds for all later coelacanth. *Coelacanthus*, although more progressive, differs markedly from *Rhabdoderma* only in the presence of an extracleithrum. *Spermatodus* appears to be most closely related to *Coelacanthus* (Moy-Thomas, 1939). Besides other similarities in the construction of brain case, both show a reduction in the ossification of the orbital region.

Our present knowledge indicates that the

coelacanth flowered in the Triassic. The number of known distinct Triassic genera is certainly greater than in any other period (Fig. 11). The forms from Spitzbergen *Axelia*, *Sassenia*, *Scleracanthus*, and *Myliacanthus* are apparently a natural group branching off the line leading to the later Mesozoic forms. There are numerous details of the neurocranium which demonstrate this relationship (Stensiö, 1921, pp. 120-129), and also the close affinities of this entire group to *Coelacanthus* on the one hand and the later Mesozoic genera on the other.

Scleracanthus has a dentition adapted for crushing. It is closely related to *Axelia* but has a more robust pterygoid, more specialized dentition and differently shaped scales. *Myliacanthus* is closely related to *Axelia* in having a less specialized dentition. *Heptanema* is very difficult to distinguish (Moy-Thomas, 1935) from *Scleracanthus*, while the latter is also considered by the same author to be very close to *Whitea*. A basic character uniting this *Axelia* group is the shape and configuration of the pterygoquadrate complex. In *Axelia*, the pterygoid is large and thick with a very broad posterior vertical limb and a long, thin anterior horizontal limb. In *Myliacanthus* the posterior limb is narrow but longer; in *Scleracanthus* it is also long but wider. The latter is also true of *Whitea* and *Heptanema*. The metapterygoid and quadrate are strongly and independently ossified in this group.

Wimania, while it may belong to the *Axelia* group, shows more definite affinities to *Coelacanthus* and *Rhabdoderma* and may have to be placed in a separate family. This conclusion is based on the shape of the parasphenoid, the pterygoid, the cheek plates, and the large opercular.

Stensiö considers *Laugia* to be very suggestive of *Coelacanthus*, the neurocranium exhibiting about the same degree of ossification. He points out that the neurocranium is certainly intermediate between the condition found in *Diplocercides* and such later forms as *Axelia* and *Macropoma*. In a number of the characters of the postcranial skeleton, previously enumerated,

GEOLOGICAL AND GEOGRAPHICAL DISTRIBUTION OF THE COELACANTHINI											
	North America	Brazil	Greenland	Spitzbergen	British Isles	Germany, German and Italian, Tirol	France, Spain, Belgium	U.S.S.R.	Syria (Mt Lebanon)	S. Africa, Madagascar	Australia
Recent										Latimeria	
Cretaceous					Macropoma	Macropoma			Macropoma		
Jurassic		Mawsonia			Coccoderma	Macropoma, Coccoderma, Libys					Coelacanth
Triassic	Osteolepiscus, Diplurus			(Lower Triassic) Wimania, Wassenia, Axelrodia, Rhabdanthus, Scleracanthus		Graphurus, Heptanema	Undina			Coelacanth, Coelacanthus, Whitea	
Permian			Laugia		Coelacanthus	Coelacanthus					
Carboniferous	Spermatodus, Rhabdoderma				Rhabdoderma	Rhabdoderma	Rhabdoderma	Rhabdoderma			
Upper Devonian						Diplocercus, Nesides, Euporosteus					Leont. Prondia del.

Figure 11.

Laugia is quite specialized and must represent an offshoot from the *Coelacanthus* type in the Permian.

Osteopleurus resembles *Coelacanthus* with respect to the postcranial skeleton except for the apparent very great difference in the shape of the pelvic plates. The former must represent a line isolated from the more central types in the Permian.

Coccoderma, *Libys*, and *Undina* appear to be rather closely related. For instance, in each the dermopalatine is an independent bone along the anterior limb of the pterygoid. In other forms it is fused with the pterygoid. Other details of the skull also bear out this conclusion. The direct derivation of this group from the *Coelacanthus* type is indicated not only by the construction of the skull, but also by the details of the postcranial skeleton.

There are a number of minor details in the construction of the dermal cranial roof which indicate relationship between *Macropoma* and the *Axelia* group. For instance, *Macropoma* and *Whitea* have a very similar supraorbital series. The shape of the pelvic plates is another example.

Mawsonia seems to be most closely related to *Undina*, more distantly to *Macropoma*. Both have the metapterygoid partially fused with the pterygoid. Other details of the skull are very similar.

Latimeria is considered by Smith to be more closely related to a *Rhabdoderma-Wimania* type than to *Macropoma*, although it bears a strong superficial resemblance to the latter. This conclusion appears to be supported by the pattern of the dermal cheek bones, the method of lower jaw suspension, and the presence of an extracleithrum.

The method of lower jaw suspension in

Latimeria is worthy of further comment, as it not only articulates in the usual manner with the quadrate, but also separately with the symplectic. Smith points out that two distinct sockets can be observed in the lower jaw of *Diplocercides*, and he has tentatively identified the symplectic in *Wimania* and *Axelia*, indicating a similar type of jaw suspension in these forms. That this condition is common to all coelacanth is doubtful as there is no evidence of its existence in the well-known *Macropoma* (Watson, 1921) or in *Undina*. The symplectic bone likewise articulates with the lower jaw in *Amia*, making a joint which is functionally more important than that formed with the quadrate. There is no evidence, however, to support Smith's suggestion that this relationship between the mandibular and hyoid arches in *Latimeria* is "the typically primitive one." It appears quite certain that this double suspension of the lower jaw has been independently acquired in the coelacanth and the amioids.

The hyomandibular, which is very well developed in *Latimeria*, has been generally considered to be reduced in all coelacanth. Smith considers an element in *Wimania*, identified by Stensiö as an epihyal, to be an ossified portion of the hyomandibular. In any case, there is now good evidence for believing that the coelacanth hyomandibular was much larger than has been formerly supposed, although it may have been mostly cartilaginous as in *Latimeria*. The hyomandibular, representing the more dorsal part of the same embryonic mass which gives rise to the symplectic, necessarily supports the latter and hence could not have been reduced, at least in the forms having the double suspension of the lower jaw.

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AFRICAN TACHINIDAE—III

By C. H. CURRAN

The preceding papers in this series were published in Novitates Nos. 751 and 1022. The present contribution contains descriptions of a number of species that appear to be of considerable economic importance in the control of pests of cultivated crops. Unless otherwise stated the types are in The American Museum of Natural History.

DEXILLA WESTWOOD

The species placed in *Dexia* in my papers on the African Tachinidae belong to *Dexilla* as recently pointed out by Townsend. The following key will separate the species known to me.

TABLE OF SPECIES

- 1.—Legs reddish.....2.
Legs black.....8.
- 2.—Bend of fourth vein with appendage...3.
Bend of fourth vein without appendage.....7.
- 3.—Third vein with two or three basal setae, if with two the abdomen not vittate.....4.
Third vein with a single basal seta; abdomen vittate...*unisetata* Curran.
- 4.—Facial carina broadened and rather flattened below; antennae reaching less than halfway to vibrissae....6.
Facial carina sharp throughout; antennae reaching at least halfway to vibrissae.....5.
- 5.—Pollen brown-ochreous or cinnamon brown; veins strongly clouded with brown.....9.
Pollen cinereous; veins weakly clouded with brownish (Europe)...*rustica* Fabricius.
- 6.—Abdomen with median dark vitta (Kenya).....*orphne* Curran.
Abdomen with black apical seg-

- mental fasciae (Cameroons).....
.....*venusta* Curran.
- 7.—A broad median vitta and lateral margins of the abdomen blackish, the intervening yellowish area whitish pollinose....*varivittata* Curran.
Abdomen with median dark vitta and yellowish pollen (Uganda)....
.....*inappendiculata* Austen.
 - 8.—Mesonotum with four black vittae (Cape).....*pusio* Walker.
Mesonotum with three black vittae (Cape).....*lugens* Wiedemann.
 - 9.—Proboscis wholly pale reddish....10.
Proboscis brown beneath, the abdomen mostly brownish in ground color (S. Rhodesia).....
.....*cuthbertsoni*, n. sp.
 - 10.—Abdomen with milky white pollen (S. Rhodesia).....*rhodesia*, n. sp.
Abdominal pollen yellowish.....11.
 - 11.—Crossveins on apical half of wings conspicuously clouded with brown (Cape).....*afra* Curran.
Apical half of the wing rather uniformly brown except behind, the crossveins only slightly darkened (Liberia).....*bequaerti*, n. sp.

Dexilla cuthbertsoni, new species

Blackish, the legs yellowish; fourth abdominal segment sometimes reddish; proboscis brown. Length, 7 to 9 mm.

FEMALE.—Head blackish, the face reddish in ground color. Front wider than one eye, dull brown; six to nine pairs of frontals and two pairs of strong orbitals; ocellars long; outer verticals short; parafrontals with only a few scattered hairs. Occiput with the pollen brown above, yellowish below. Cheeks almost as wide as the eye-height, the anterior portion brownish red. Parafacials wide, with pale brassy yellow pollen; middle of face with pale yellowish pollen, the carina conspicuously widened below. Palpi yellow. Proboscis brown with yellow

labellae. Antennae reddish, the arista with long black rays.

Thorax black, the pleura cinereous pollinose; mesonotum brown pollinose with the sides cinereous yellow to dull golden-yellow, with four slender black vittae and a black stripe on each side behind the base of the wings. Acrosticals 1-1; dorsocentrals 2-3 or 3-3; two intra-alars and two sternopleurals. Hair black. Scutellum brown with the free border cinereous or yellowish pollinose.

Legs reddish; tarsi black.

Wings very strongly tinged with dark brown, the base broadly pale. Squamae tinged with brown.

Abdomen black, the fourth segment sometimes reddish; pollen brown, toward the sides of the second segment sometimes mostly cinereous except apically, the hairs and bristles arising from black spots. Hair wholly black. Second segment with a pair of marginals, the third and fourth each with a row.

TYPES.—Holotype, female, and three paratypes, females, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Dexilla rhodesia, new species

Mostly reddish, with whitish and cinnamon brown pollen. Length, 8 mm.

FEMALE.—Head reddish in ground color, the parafrontals and part of the occiput above the middle black; pollen white, brownish on the parafrontals. Front almost half as wide as the head, gently widening anteriorly; eight or nine pairs of frontals, the upper pair reclinate; two pairs of proclinate orbitals; hair short, coarse and sparse; ocellars long and strong; outer verticals scarcely differentiated. Occiput with sparse black bristly hair and with yellowish pile beneath the neck. Cheeks as wide as the eye-height. Vibrissae strong; one to three weak bristles above them. Facial ridge yellowish, of medium width. Proboscis and palpi reddish yellow. Antennae pale orange, the arista brownish at the base.

Thorax reddish, the mesonotum mostly blackish in ground color; pollen whitish on the pleura and sides of the mesonotum, cinnamon brown dorsally, but the whitish pollen extends inward in front of the suture. The dark vittae are represented by a pair of short, interrupted dorsocentrals, a triangular sublateral spot in front of the suture and a short sublateral stripe behind the suture; above the base of the wings is a large opaque black spot. Acrosticals 0-1; dorsocentrals 2-3; two sternopleurals; three pairs of strong marginal scutellars, the apical pair decussate.

Legs reddish, the tarsi becoming brownish apically.

Wings tinged with brown, brownish along the veins and in the stigmal cell; the base whitish. Squamae whitish. Halteres yellow.

Abdomen reddish with white pollen above, the sides with pale brownish pollen, the venter cinereous pollinose. The hairs arise from small brown spots, the bristles from large ones, giving a fasciate appearance to the segments, the first segment mostly brownish.

HOLOTYPE.—Female, Salisbury, Southern Rhodesia, December 24, 1911.

Dexilla bequaerti, new species

Abdomen reddish yellow with incomplete median black vitta and dark segmental apices; wings brownish on apical two-thirds except behind. Length, 10 mm.

MALE.—Head blackish in ground color above, the lower half reddish yellow; pollen cinereous, yellowish on the front and parafacials. Front narrow above, strongly widening on the anterior half; seven pairs of frontals and two or three bristly hairs; ocellars long and strong; verticals weak. Occiput with coarse black hairs, below the neck with sparse yellow pile. Cheeks almost three-fourths as wide as the eye-height, the anterior soft part pale reddish brown. Facial carina sharp on its whole length. Proboscis and palpi reddish yellow. Antennae pale orange, the rays of the arista brown.

Thorax blackish in ground color, the humeri and anterior and posterior portions of the pleura yellowish. Pollen cinereous on the pleura and sides of the mesonotum, brownish on the dorsum, the black vittae conspicuous. Acrosticals 1-1; dorsocentrals 3-3; three pairs of strong marginal scutellars, the apical pair cruciate; two sternopleurals.

Legs reddish, the tarsi black.

Wings brownish on almost the apical two-thirds except posteriorly, yellowish brown basally, grayish posteriorly, the bend of the fourth vein with a short appendage, the cross-veins scarcely darkened. Squamae brownish yellow. Halteres yellow.

Abdomen rusty reddish yellow, with a black median vitta extending from the base to the apex of the third segment and with apical segmental fascia formed by blackish dots about the bases of the bristles. Pollen rich brownish yellow, practically absent on the sides and under surface, the hairs arising from pale brown spots.

HOLOTYPE.—Male, Du River Camp No. 3, Liberia (J. Bequaert).

HERMYA DESVOIDY

DESVOIDY, 1830, Mem. Acad. Roy. Sci. Inst. France, IV, p. 266.

Paraphania BRAUER and BERGENSTAMM, 1889, Denk. Akad. Wissen. Wien., LVI, p. 141.

Liancosmia SPEISER, 1910, Kil.-Meru. Exped., X, p. 157.

With the exception of *ditissima* Speiser all of the species of *Hermyna* closely resemble each other. All are black with the

head, thorax and abdomen more or less pollinose; the wings are blackish with more or less violaceous reflections (only in *pictipennis*, n. sp., with yellowish in the middle anteriorly); antennae black, the base of the third segment sometimes partly reddish. The bristles of the thorax are somewhat variable, but there are normally three posterior dorsocentrals and three sternopleurals. In *ditissima* Speiser there may be one to three posterior dorsocentrals and two to three sternopleurals and the apical cell may be closed or narrowly open as in the other species.

In the species before me the male genitalia are distinctive and readily separate the species. The females are difficult to separate and apparently display no characters except in the arrangement of the pollen and the color of the squamae.

Townsend (Manual of Myiology, III, pp. 74, 75) separates *Liancosmia* Speiser on the presence of only two sternopleurals, one postsutural dorsocentral and the closed apical cell. I have not seen a specimen with only two sternopleurals but the material before me shows the other characters mentioned, in some specimens. In view of the variation *Liancosmia* must be placed as a synonym of *Hermya*. On page 75 Townsend states that the third vein is bare but this is not the case. All of my specimens have the third vein haired but the hairs are difficult to see because of the dark color of the wing. Of the characters used by Townsend for the separation of *Hermya* and *Orectocera* Wulp (p. 75) only the comparative length of the vibrissae is of value. Infra-squamal setulae are usually present but they are very fine, vary in number and are difficult to see.

TABLE OF SPECIES

- 1.—Abdomen reddish...*ditissima* Speiser.
Abdomen black in ground color...2.
- 2.—Face golden.....3.
Face whitish, sometimes with brassy
tinge.....4.
- 3.—Wings conspicuously bicolored, the
costa broadly dull yellowish on the
median half...♂*pictipennis*, n. sp.
Wings not bicolored, brownish black,

- becoming brown posteriorly.....
.....♂*diabolus* Wiedemann.
- 4.—Lower lobe of squamae brownish....
.....♂*nitida*, n. sp.
Lower lobe of squamae white, usually
with brown rim.....5.
 - 5.—Squamae without brown rim.....
.....♀*diabolus* Wiedemann.
Squamae with deep brown border..6.
 - 6.—Face brassy.....10.
Face pure white.....7.
 - 7.—Male.....*albifacies*, n. sp.
Females.....8.
 - 8.—Abdomen, from anterior view, with-
out pollen on the dorsum.....
.....♀*nitida*, n. sp.
Abdomen with pollen on the dorsum
.....9.
 - 9.—Abdomen mostly pollinose above...
.....♀*confusa*, n. sp.
Abdomen with a faint, median, white
pollinose vitta on the basal half or
more, more extensively pollinose
apically.....*albifacies*, n. sp.
 - 10.—Abdomen, viewed from certain angles,
wholly whitish pollinose; arms of
posterior forceps obtuse apically;
second abdominal segment without
marginals.....*confusa*, n. sp.
Abdomen whitish pollinose on the
middle and sides, brownish polli-
nose between; arms of posterior
forceps acute apically; second ab-
dominal segment with pair of
marginals.....*vittata*, n. sp.

Hermya ditissima Speiser

Liancosmia ditissima SPEISER, 1910, Kil-
Meru. Exped., X, p. 157.

This species is easily distinguished by the orange-colored abdomen and scutellum and the orange and black-striped mesonotum. The posterior dorsocentrals vary from one to three and the apical cell may be closed just before the wing margin. The abdomen is not quite as elongate as in the other species. I have material from Liberia and the Belgian Congo.

Hermya diabolus Wiedemann

Ocyptera diabolus WIEDEMANN, 1819, Zool.
Mag., III, p. 26.

Tachina diabolus WIEDEMANN, 1830, Ausser.
Zweif., II, p. 302.

H. afra DESVOIDY, 1830, Mem. Acad. Roy. Soc. Inst. France, IV, p. 227.

H. hottentota DESVOIDY, 1830, idem., p. 227.

Paraphania diabolus BRAUER AND BERGENSTAMM, 1889, Denkschr. Akad. Wissen. Wien, p. 141.

Townsend (Manual of Myiology, IV, pp. 270, 276, and VII, p. 122) places *afra* and *hottentota* as synonyms of *diabolus*, repeating the synonymy given in Ann. Mag. Nat. Hist., VIII, p. 389, 1931. The types of the Desvoidy species are lost and the synonymy should be accepted to avoid confusion. There can be little doubt that the above names refer to the same species since all were from the Cape of Good Hope.

In the male the face and parafrontals are golden pollinose, the occiput with white pollen and pile; basal antennal segments and base of third brownish red. Thorax with white pollen, the mesonotum with four black vittae that appear brown when seen from in front and do not nearly reach the posterior border. Squamae brown with white base. Abdomen black, from certain views thinly covered with whitish or pale yellowish pollen, the sides and under surface more thickly pollinose. The posterior forceps are united basally, the basal portion truncate apically and with a long, rather stout arm extending forward on each side, these arms obtuse and converging apically.

In the female the head is white pollinose and the squamae are wholly white with pale yellowish rim. The abdomen is more thickly white pollinose.

Specimens before me are from Liberia, Belgian Congo and Southern Rhodesia.

Hermya nitida, new species

Shining black, with thin pollen; facial pollen with brassy tinge. Length, 14 to 16 mm.

MALE.—Face with very pale brassy yellowish pollen; front black, the pale pollen extending from the face almost to the middle of the parafrontals; occiput with cinereous pollen and pale yellow pile; parafacials and cheeks reddish in ground color; second antennal segment brownish red.

Thorax with whitish pollen; mesonotum with four black vittae, the outer pair very broad; mesopleura with brownish pollen.

Wings blackish with violaceous reflections; squamae brownish with white base.

Abdomen shining above, the under surface thinly cinereous and yellowish-brown pollinose.

Arms of the posterior forceps about one-fourth as long as the basal section, their apical half directed obliquely upward (away from the body when *in situ*).

FEMALE.—Pollen silvery white, the parafacials black on the outer half. Under surface of abdomen with thicker, cinereous pollen. Squamae white, the border narrowly brown.

TYPES.—Holotype, male, Stanleyville, Congo, April 10, 1915; allotype, female, Stanleyville, March, 1915; paratype, male, Lisala, Congo, October, 1924 (J. Bequaert). The two types were collected by Lang and Chapin.

Hermya confusa, new species

Black, with whitish pollen; squamae white with brown rim. Length, 13 to 15 mm.

MALE.—Head with pale brassy pollen, the parafrontals brown, the occiput white pollinose and pale yellow pilose; parafacials and cheeks reddish in ground color; base of third antennal segment narrowly reddish.

Thorax with white pollen, that on the mesonotum thin and divided by four black vittae that are sometimes only narrowly separated.

Squamae white with brown border.

Abdomen with white pollen on the whole surface when seen from certain angles, the pollen thicker on the sides and ventral surface. Second segment usually with a pair of discs in front but without marginals; third usually with a pair of discs and marginals. Arms of the posterior forceps about one-third as long as the basal section, carried straight forward and with obtusely rounded apex.

FEMALE.—Face white pollinose; abdomen much more conspicuously yellowish-white pollinose.

TYPES.—Holotype, male, Stanleyville, Congo, March, 1915; allotype, female, Stanleyville, April, 1915. Paratypes: male, Stanleyville, September 26-30, 1910; three males, Medje, Congo, July, August and September, 1910, and one male, Bengamisa, Congo, September 29, 1914; all collected by Lang and Chapin.

Hermya vittata, new species

Abdomen with whitish pollinose median vitta and brown pollen on at least the two basal segments and sometimes on the third; face with brassy tinge. Length, 13.5 to 14 mm.

MALE.—Pollen white, on the face with slight to strong brassy tinge; occiput white pollinose and pilose; second antennal segment and narrow base of the third more or less reddish.

Thorax with whitish pollen, the black mesonotal vittae broad, those on each side only weakly separated from each other.

Squamae white with brown border.

Abdomen with the fourth segment, sides, under surface and a median dorsal vitta white pollinose, the vitta with or without yellow tinge, the second and sometimes the third segment brown pollinose. Second and third segments each with a pair of discals and marginals. Arms of the posterior forceps one-third as long as the basal section, straight and tapering to the apex.

Types.—Holotype, male, Eden, Cameroons (J. A. Reis); paratype, male, Stanleyville, Congo, March, 1915 (Lang and Chapin).

The male is readily distinguished from related species by the straight, acute arms of the posterior forceps, and from *confusa*, in addition, by the presence of marginals on the second abdominal segment. The female should also show marginals on this segment.

Hermya albifacies, new species

Face white pollinose in both sexes; squamae white with brown border; abdomen wholly thinly white pollinose. Length, 11 to 12 mm.

Male.—Face and occiput white pollinose; pile of the occiput white. Second antennal segment and base of third obscurely reddish.

Thorax with white pollen, the mesonotum with four shining black vittae, those on each side only narrowly separated from each other.

Squamae white, with brown border.

Abdomen thinly white pollinose above, more thickly so below. Second to fourth segments each with a pair of discals, the second with two, third with four, the fifth with a row of marginals.

Female.—Head missing. Pollen of thorax and abdomen as in the male, second abdominal segment without marginals, third with two, the fourth without apical row.

Types.—Holotype, male, Stanleyville, Congo, April 7, 1915; allotype, female, Stanleyville, March, 1915; paratype, male, Stanleyville, March, 1915, all collected by Lang and Chapin.

This species is smaller and narrower than any of the others and the male is readily recognized by the pure white face. The arms of the genitalia are at least one-third as long as the basal part, slender and slightly clavate apically.

Hermya pictipennis, new species

Wings brown, with a broad yellowish costal stripe extending from the basal fourth to the apical third. Length, 12 mm.

Male.—Face and cheeks golden; front dull black, with a white spot on each side anteriorly; occiput white pollinose, pale yellow pilose; apex of the second and base of the third antennal segments reddish.

Thorax with cinereous pollen, the mesonotum with four dark brownish vittae, the mesopleura brownish on the anterior half.

Wings brown, paler posteriorly and in the large cells, with a dull reddish-yellow costal stripe extending from the basal fourth to the apical third. Squamae brown, with darker border and white base.

Abdomen with thin brownish pollen above and whitish pollen on the sides and under surface. Second segment with a pair of discals but no marginals, the third without discals but with pair of marginals.

Holotype.—Male, Uganda, September, 1923.

The genitalia have not been spread but the bicolored wings are distinctive.

Fischeria capensis, new species

Abdomen reddish yellow with narrow dark vitta and black apex; legs reddish; wings somewhat brownish on apical half. Length, 9 to 10 mm.

Male.—Face, anterior half of cheeks and posterior oral margin yellow in ground color, the facial depression mostly darkened, the front and occiput black; pollen white, brassy yellow on the upper third of the front and occiput. Front narrow, with parallel sides on more than the upper half, the frontal vitta deep black and of almost uniform width; hair absent; thirteen to sixteen pairs of long fine frontals, two below the base of the antennae, none reclinate; ocellars long. Verticals weak, the outer verticals weak or not differentiated. Occipital pile yellowish; occipital cilia and hair of the cheeks black. Cheeks one-sixth the eye-height, with sparse coarse hairs. Parafacials slightly narrowing below. Proboscis short; palpi yellow, cylindrical. Antennae brown, the two basal segments reddish; arista long pubescent, the rays twice as long as its basal thickness.

Thorax brownish in ground color, the pleura with cinereous, the dorsum with golden pollen which leaves four narrow, incomplete and interrupted shining black vittae. Acrosticals 2-1 or 3-1; dorsocentrals 3-3; intra-alars 3; sternopleurals 2-1. Scutellum brownish with yellowish apex, the pollen golden or golden brown.

Legs reddish yellow, the tarsi black. Claws and pulvilli elongate.

Wings hyaline basally, strongly tinged with brown on the apical half. Squamae translucent pale brownish. Halteres yellow.

Abdomen elongate conical, yellowish or reddish yellow, the hair black. First and second segments and basal half of the third with narrow black or brown vitta, the third blackish on the apical half or less; fourth segment shin-

South Africa, May 7, 1925 (H. K. Munro); returned to Mr. Munro.

This species is readily distinguished from all others known to me by the presence of the single bristle on the first vein.

Siphona bevisi, new species

Rusty yellowish, with dark mesonotum and abdominal apex; first vein setulose on whole length. Length, 4.5 mm.

MALE.—Front with brownish-orange pollen, the parafrontals with cinereous pollen on the outer half or less; five or six pairs of frontals. Occiput brownish in ground color, grayish pollinose, the orbits whitish. Face, cheeks and lower occiput yellow, white pollinose. Cheeks about one-fifth as wide as the eye-height. Parafacials with a few weak setulae above. Palpi yellow, moderately long and gently curved; proboscis yellowish, brown on the median half, slightly longer than the body. Antennae brownish, the basal segments more reddish; third segment wide, about two and a half times as long as wide, the lower apex broadly rounded. Arista brown, the second segment about one-third as long as the apical segment.

Mesonotum dark in ground color; pollen whitish on the sides of thorax, grayish brown on the mesonotum. Scutellum brownish, the apex broadly yellow.

Legs reddish yellow, the tarsi black.

Wings cinereous hyaline; first vein with bristles on the whole length, the third bristled to well beyond the small crossvein. Squamae white.

Abdomen rusty yellowish, the broad apices of the third and fourth segments, and a median vitta on the fourth, brown, the bases of the segments with whitish pollen. Hair black, appressed.

HOLOTYPE.—Male, Umbilo, Durban, Natal, August 16, 1914 (A. L. Bevis).

The setose first vein distinguishes this from all described African species.

Siphona cuthbertsoni, new species

Blackish, with brownish and brownish-yellow pollen and with brown palpi. Length, 4.5 mm.

MALE.—Front and occiput black in ground color, the parafrontals brownish-yellow pollinose, the frontal vitta reddish brown; six or seven pairs of frontals and two pairs of orbitals. Face, cheeks and the broad posterior oral border reddish yellow in ground color and dull yellowish pollinose. Cheeks not over one-seventh as wide as the eye-height. Parafacials with two or three setulae above. Palpi brown, becoming reddish basally; proboscis brown, as long as the body. Antennae black, not large, the third segment two and one-half times longer than wide, the lower apex broadly rounded, the upper

apex sharply rounded. Arista black, the second segment not over one-fifth as long as the third.

Thorax black, cinereous pollinose, the mesonotum cinereous yellow, with three broad brownish vittae. Apex of scutellum yellow, the pollen cinereous yellow.

Legs reddish, the tarsi black; apices of the femora darkened above.

Wings cinereous hyaline, third vein bristled almost to the small crossvein. Squamae grayish yellow.

Abdomen blackish, the sides broadly reddish on the basal half, the under surface reddish yellow on more than the basal half; pollen grayish yellow, the hairs arising from the darker spots so that the abdomen appears brownish with broad, pale incisures.

FEMALE.—Frontal vitta brownish red. General color slightly darker, the abdomen without reddish.

TYPES.—Holotype, male, Salisbury, Southern Rhodesia, December, 1934, and allotype, female, Salisbury, January, 1935 (A. Cuthbertson).

Siphona capensis, new species

Palpi brownish on apical half; antennae brownish red basally. Length, 4 mm.

FEMALE.—Front dull orange, the parafrontals grayish-yellow pollinose; six or seven pairs of frontals. Occiput black in ground color, except behind the mouth, cinereous pollinose, the orbits whitish. Face and cheeks yellow, white pollinose. Cheeks about one-seventh as wide as the eye-height; parafacials becoming almost linear below, with two or three setulae above. Palpi reddish basally, brown on the apical half; proboscis brown, shorter than the body. Antennae black, the basal segments brownish red, the third segment almost three times as long as wide, the lower apex broadly rounded. Arista black, the second segment about one-sixth as long as the third.

Thorax cinereous pollinose, the mesonotum cinereous yellow and with three brown vittae that do not reach the anterior margin. Scutellum cinereous pollinose, the apex broadly reddish yellow.

Legs reddish, the tarsi black. Front tarsi simple.

Wings cinereous hyaline. Squamae with grayish-yellow tinge.

Abdomen with cinereous yellow pollen; first segment with a pair of well-separated brown spots posteriorly, the following segments each with an elongate median spot on the basal half forming an interrupted vitta, the hairs arising from somewhat darker spots.

HOLOTYPE.—Female, East London, South Africa, March 28, 1923 (H. K. Munro); returned to Mr. Munro.

***Siphona obscuripennis*, new species**

Blackish, the wings considerably infusate; mesonotum with five brown vittae and additional spots. Length, 5 mm.

FEMALE.—Front and occiput black in ground color, the front brown pollinose with the orbits dull yellowish; five pairs of frontals. Occiput cinereous pollinose, the orbits yellowish. Face, cheeks and lower occiput yellow, the face pale dull yellowish pollinose, the cheeks with whitish pollen. Cheeks one-fifth as wide as the eye-height. Parafacials very slightly narrowing below, with three or four setulae above. Palpi reddish with brown tips; proboscis brown, longer than the body. Antennae blackish; third segment scarcely three times as long as wide, narrowing basally, widest at the apical fifth, the lower apex very broadly rounded. Second segment of arista a little more than one-fourth as long as the third segment.

Thorax black, the pleura cinereous pollinose, the humeri grayish yellow. Mesonotum yellowish brown, with five brown vittae, the middle and outer ones complete, the dorsocentral pair extending to behind the middle, and in addition with brown spots so that the mesonotum is chiefly brown. Scutellum with yellow apex, the pollen brown.

Legs reddish, the tarsi black; tips of femora blackish, at least on upper surface.

Wings strongly tinged with blackish brown, especially in front. Squamae cinereous white.

Abdomen blackish, the incisures broadly grayish yellow, the sides of the first segment and the basal half of the venter reddish yellow. The pollen is grayish yellow, the apical half of the segments with more or less shining, interrupted or entire brownish bands resulting from the spots surrounding the bristles.

HOLOTYPE.—Female, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson, 4095).

***Siphona vittata*, new species**

Arista wholly black; abdomen mostly reddish. Length, 4 to 5 mm.

MALE.—Front golden-brown to reddish brown, the parafrontals brownish golden; five pairs of frontals; posterior orbital weak. Front and occiput black in ground color, the occiput cinereous pollinose. Face, cheeks and lower occiput yellow, white pollinose. Cheeks about one-sixth as wide as the eye-height. Parafacials narrow, with a single row of three to five setulae above. Palpi reddish; proboscis not as long as the body, black with the apex broadly reddish. Antennae black, the basal segments short, reddish; third segment broad, about two and one-half times longer than wide, the apex broadly rounded. Second arisal segment about one-fifth as long as the third, three or four times as long as wide.

Thorax black, the humeri and pleura cinereous pollinose, the mesonotum brownish yellow,

somewhat golden, with three brownish vittae which are darker and contiguous in front, the median one paler, sometimes weak and always obsolete behind. Scutellum brown with the apical third yellow.

Legs reddish, the tarsi black.

Wings with light brownish tinge. Squamae tinged with luteous.

Abdomen reddish, with a narrow median black vitta and dark spots surrounding the bristles, particularly on the third segment. The third segment has a dark, sometimes blackish spot, laterally surrounding the bristles and the fourth is more or less darkened in ground color laterally in the middle and bears a definite brownish spot on the under surface. The spots from which most of the hairs arise are reddish and inconspicuous, the incisures narrowly whitish.

FEMALE.—Frontal vitta golden-brown above, becoming yellowish in front; base of third antennal segment broadly reddish, the second segment of the arista little more than twice as long as wide; dark spots on abdomen larger and more conspicuous, each segment with dark lateral spots. In the female the ground color of the abdomen is mostly brownish.

TYPES.—Holotype, male and paratypes, three males, Salisbury, Southern Rhodesia, April 30, 1938 (C1085), and allotype, female, Salisbury, June 1935 (A. Cuthbertson).

***Siphona nigroseta*, new species**

Blackish, with cinereous and brownish-gray pollen; arista wholly black. Length, 4 mm.

FEMALE.—Frontal vitta brownish yellow; pollen rather ochraceous; six or seven pairs of frontals; upper orbital strong. Parafrontals and occiput dark in ground color; occiput with cinereous pollen. Face, cheeks and lower occiput yellow, white pollinose. Cheeks almost one-fourth as wide as the eye-height. Parafacials narrowing below, with four to six setulae above. Palpi yellow; proboscis brown, as long as the body. Antennae black, the basal segments brownish red; third segment rather narrow, the lower apex broadly rounded. Second segment of the arista one-third as long as the third, the arista wholly blackish.

Thorax black, cinereous pollinose, the mesonotum with pale brownish-yellow pollen and with indications of a narrow median brown vitta on the posterior half; apex of scutellum reddish.

Legs reddish, the tarsi black; apical three segments of front tarsi slightly broadened.

Wings cinereous hyaline. Squamae whitish.

Abdomen black, with very pale brownish-yellow pollen, the incisures and venter cinereous. The dorsum of the abdomen is almost uniform in color but the bristles arise from conspicuous shining brown spots.

HOLOTYPE.—Female, Pretoria, Transvaal, January 23, 1931 (H. K. Munro); returned to Mr. Munro.

Siphona laticornis, new species

Black, with pale pollen; second arisal segment yellowish. Length, 4 to 4.5 mm.

MALE.—Frontal vitta dull orange to brownish orange, the parafrontals with brownish yellow to ochraceous pollen, the orbits rather whitish; five or six pairs of frontals. Parafrontals and occiput black in ground color, the occiput cinereous pollinose. Face, cheeks and lower occiput yellow, white pollinose. Cheeks one-fifth as wide as the eye-height. Parafacials slightly narrowed below, with four to six setulae above. Palpi yellow; proboscis not quite as long as the body. Antennae black, the basal segments reddish; third segment very broad, about twice as long as wide, the lower apex rather sharply rounded; second segment of the arista reddish, almost to quite one-third as long as the third segment.

Thorax black, the pleura and sides of the mesonotum cinereous pollinose, the mesonotum with yellowish-brown pollen posteriorly which becomes cinereous in front of the suture, the anterior border with indications of the beginning of three dark vittae. Scutellum with yellowish apex.

Legs reddish, the tarsi black.

Wings cinereous hyaline. Squamae yellowish white.

Abdomen reddish with cinereous yellow pollen, a narrow black vitta on the second and third segments, the bristles arising from large dark spots, or the abdomen may be much more extensively dark in ground color due to the fusion of the dark areas.

TYPES.—Holotype, male, Pretoria, South Africa, September 23, 1917, and paratype, male, East London, S. Africa, February 17, 1919 (H. K. Munro); the type returned to Mr. Munro.

Siphona vixen, new species

Blackish, the abdomen largely reddish; base of third antennal segment reddish. Length, 5 mm.

FEMALE.—Front and occiput black in ground color; frontal vitta brownish red, the parafrontals brownish yellow with the orbits grayish on the lower half; five or six pairs of frontals; anterior orbital strong, the posterior weak. Occiput cinereous pollinose, yellow in ground color on almost the lower half. Face and cheeks yellow, white pollinose. Cheeks almost one-fourth as wide as the eye-height. Parafacials narrowing below, with four to six setulae above. Palpi yellow; proboscis considerably shorter than the body. Antennae reddish, the third segment black on the apical three-fourths, rather narrow, the lower apex very broadly rounded.

Thorax black, the pleura and sides of the mesonotum cinereous pollinose, the mesonotum reddish-brown pollinose, becoming grayish in front,

in the middle with a reddish brown vitta. Scutellum brown with reddish apex.

Legs reddish, the tarsi black; apical segments of the front tarsi distinctly widened.

Wings tinged with brown, especially in front. Squamae yellowish with brown reflection.

Abdomen brown and reddish, usually mostly reddish, with brown median vitta that expands to unite with the dark spots surrounding the bristles on the second and third segments, and with large brown spots surrounding the bristles on the fourth segment and on the sides and under surface of the intermediate segments, the pollen dull yellowish. At times the dark areas are extended so that the abdomen is almost half brownish above and chiefly brownish on the under surface.

TYPES.—Holotype, female, and paratype, female, Salisbury, Southern Rhodesia, January 1935 (A. Cuthbertson); paratype, female Pretoria, Transvaal, February 3, 1916 (H. K. Munro).

Siphona geniculata De Geer

Musca geniculata DE GEER, 1776, Mem. Ins., VI, p. 20 (f.).

This species has been recorded from northern Africa but is not represented in the material before me.

Kuwanimyia africana, new species

Black with cinereous pollen; apical cell closed. Length, 4.5 mm.

MALE.—Head cinereous pollinose, the hair black. Front one-third the head-width, slightly widening anteriorly; six pairs of frontals, the upper two reclinate, the lower situated below the apex of the second antennal segment; parafrontal hair sparse; ocellars long; outer verticals short and poorly developed; occipital pile whitish. Cheeks one-seventh as wide as the eye-height, with sparse hair. Parafacials narrow. Facial depression deep, the oral margin but little produced. Face receding in profile, the ridges with six bristles on lower two-thirds. Palpi reddish. Antennae black, the basal segments short, the third segment long and broad, reaching to the oral margin, the apex truncate with the lower corner rounded; arista thickened on less than the basal half, the second segment four or five times as long as thick, not as long as the thickened portion of the third segment. Eyes bare, the antennae arising opposite their upper fourth.

Thorax cinereous pollinose, the mesonotum with four black vittae and with some brownish pollen on disc behind the suture; acrosticals 3-3; dorsocentrals 3-4; three intra-alars and three sternopleurals. Scutellum black, the border with thin cinereous pollen.

Legs black; claws and pulvilli short; middle

tibiae with two strong antero-dorsal bristles, the posterior tibiae with isolated bristles.

Wings cinereous hyaline, the veins mostly luteous; apical cell closed just before the wing margin, ending well before the tip of the wing; third vein with three bristles basally. Squamae whitish, with pale yellow rim; halteres brown.

Abdomen shining black; second segment with narrow interrupted basal fascia, the third and fourth with wider, interrupted basal white pollinose fasciae, that on the fourth occupying more than the basal third of the segment, that on the second linear and sometimes partly obliterated. First segment with a pair of weak marginals, the second with stronger pair; third and fourth segments with row of marginals, the fourth with a row of discals.

TYPES.—Holotype, male, and paratype, male, Salisbury, Southern Rhodesia, November 13, 1936, from nest of *Dasyproctus bipunctatus* in gladiolus.

This species differs from the genotype by the presence of weak marginals on the first abdominal segment.

Phorocera leo, new species

Shining black; occipital pile black; face setose above. Length, 6.5 to 7 mm.

FEMALE.—Head blackish in ground color, and with black hair, the anterior oral margin and a median facial stripe yellowish; pollen cinereous white, more grayish on the parafrontals. Front two-thirds as wide as one eye; about ten pairs of frontals and two proclinate orbitals; ocellars short but rather strong. Cheeks about one-third the eye-height, the hair bristle-like anteriorly. Parafacials with hair on almost the upper third. Facial ridges with bristles on more than the lower half. Palpi brownish red. Antennae blackish, the basal segments brownish red; third segment about twice as long as the second, its upper apex angular; arista thickened on the basal half. Eyes with cinereous pile.

Thorax shining black, with rather thin brownish-gray pollen; dorsocentrals 3-4; acrosticals 3-3; sternopleurals normally 1-1-2. Scutellum broadly reddish on its free border, with three pairs of marginals and a pair of weak, more or less decussate apicals.

Legs blackish, the tibiae brownish red; posterior tibiae moderately closely ciliate.

Wings hyaline, the veins yellowish; third vein with three bristles basally. Squamae white; halteres brownish red.

Abdomen shining black; intermediate segments thinly cinereous pollinose except on a narrow median line and the broad apex, and without discals, the second segment with or without a pair of suberect marginals, the fourth segment with irregularly placed discals.

TYPES.—Holotype, female, and paratype,

female, Umtali, Southern Rhodesia, March 21 and 22, 1916. The paratype is in the Southern Rhodesia Government collection.

This species is related to *laevis* Villeneuve but may be at once distinguished by the presence of hair on the parafacials. In *laevis* there may be two or three downwardly directed hairs below the frontals, and this species has the sternopleurals 1-2.

CHROMATOPHANIA VILLENEUVE

This genus was established by Brauer and Bergenstamm for *Gonia picta* Wiedemann, and in 1913 Villeneuve added two additional species but was uncertain of the status of the second. The species may be separated as follows:

TABLE OF SPECIES

- 1.—Only two postsutural acrosticals and dorsocentrals; third antennal segment longer than the second; thorax dark reddish in ground color; no clear spot in the brown field in the apical cell. *picta* Wiedemann.
Three postsutural acrosticals and four dorsocentrals; second antennal segment as long or longer than the third. 2.
- 2.—Abdomen elongate and cylindrical (as in *picta*); no clear area in the brown field of the wing; one pair of orbitals in the male. *distinguenda* Villeneuve.
Abdomen oval; a clear area in the brown field; two pairs of orbitals in the male. 3.
- 3.—Mesopleura black pilose.
 *fenestrata* Villeneuve.
Mesopleura yellow pilose. *dubia*, n. sp.

Chromatophania dubia, new species

Thorax blackish in ground color, densely dull ochraceous or brownish-yellow pollinose; abdomen reddish to brownish, with grayish-yellow pollen. Length, 12 mm.

FEMALE.—Ground color of the head concealed by thick pollen, but partly dark and partly reddish. Front wider than one eye, ochraceous with reddish median vitta; seven to nine pairs of frontals, the upper two reclinate but the anterior of these is weak and situated outside the frontal row; two pairs of strong orbitals; ocellars and outer verticals long; frontal hair sparse and rather fine. Occiput and cheeks yellow

pollinose, the pile yellowish. Checks somewhat more than one-third as wide as the eye-height, with fine, sparse yellow hair, one or two black bristles and two or three coarse, black hairs. Parafacials clothed with yellow hair, as wide as the third antennal segment and not narrowing below. Face white pollinose, the depression not sunken. Palpi reddish, clavate. Antennae dark reddish, rising above the middle of the eyes and reaching to the oral margin, the second segment distinctly longer than the third, the third angulate above, the lower corner rounded; arista thickened to the apical fifth, the second segment about five times as long as thick and at least one-fifth as long as the third. Eyes bare.

Thorax blackish in ground color but the pleura show some yellowish areas and the humeri and scutellum are yellow. Pollen dense, ochraceous dorsally becoming cinereous on the pleura. Hair black dorsally, yellow on the pleura. Acrosticals 3-3; dorsocentrals 3-4; two intralargals; three sternopleurals; propleura pilose; prosternum bare. Two pairs of strong marginal scutellars, a weak basal pair and a pair of short decussate apicals.

Legs reddish, the tarsi black.

Wings hyaline and with yellow veins before the small crossvein, beyond brown with the apex and posterior border broadly gray and a gray area in the apical cell. Squamae dull yellowish. Halteres yellow.

Abdomen reddish to castaneous, the first segment black in the middle and basally. Hair black, yellowish on the under surface of the first segment. From posterior view the bases of the second to fourth segments are rather broadly yellowish white or white pollinose but the pollen is variable and these bands increase in width when seen from various angles. From some views the whole abdomen appears whitish or pale yellowish pollinose. Second segment with a pair of strong marginals, the third with a row, the fourth with rather weak marginals, a row of strong submarginals and a median row of discals.

Types.—Holotype, female, Mt. Mlanje, Nyasaland, October 27, 1912 (S. A. Neave). Paratype, female, Mlanje, Nyasaland, May 19, 1913 (S. A. Neave). The type is in the British Museum.

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A NEW *GALIDIA* (VIVERRIDAE) FROM MADAGASCAR

By G. H. H. TATE AND A. L. RAND

The series of ten specimens of *Galidia elegans* collected by the Mission Zoologique Franco-Anglo-Américaine à Madagascar and now in the American Museum shows that at least two local races of this species can be recognized. When I. Geoffroy (1837, Compt. Rend. Acad. Sci., Paris, V, p. 581) described this species he indicated only Madagascar as locality. However, two years later (1839, Mag. de Zool., Ser. 2, I, p. 37, Pl. xiv) he again described and figured this species and stated its range to be Madagascar, especially the environs of Tamatave. We have material of this species from both north and south of Tamatave, which agrees with the plate and descriptions, so it appears that the name *Galidia elegans elegans* is applicable to the animals of the eastern forests of Madagascar. We hereby restrict the type locality to Tamatave.

The population living in the isolated area of rain forest on Mt. d'Ambre appears separable, for which we propose the name *dambrensis*.

Galidia elegans dambrensis, new subspecies

TYPE.—No. 100487, Amer. Mus. Nat. Hist.; ♂ ad.; Mt. d'Ambre, north Madagascar, altitude 1000 meters; October 18, 1930; A. L. Rand and P. A. Dumont. The type is a skin and skull in good condition, in The American Museum of Natural History.

DIAGNOSIS.—Differs from *elegans* in being generally paler, reddish brown, and with little black in the pelage. Compared with *elegans* the top and sides of the head are fulvous brown, grizzled with black, not dull fulvous grizzled with black; rest of upper surface of body pale reddish brown, darkening to nearly chestnut on the rump, the tips of the hairs slightly darker,

and slight grizzling in the fore part of the body (in *elegans* the general coloration is darker, chestnut changing to dark chestnut on the rump and the grizzling on the pelage of the fore part of the body pronounced). In *dambrensis* the fore legs are like the back, fore feet black, hind legs like rump, distal part of foot black (in *elegans* both fore and hind limbs are darker, more blackish than the back); tail ringed black and reddish brown (in *elegans* darker); underparts of body reddish brown, the fulvous gray bases of the hairs showing through, throat more fulvous brown (in *elegans* the underparts are very different, with throat fulvous, sides of breast and rest of underparts black, more or less mingled with fulvous or grayish hairs along the mid-line, and some of the black hairs with buffy or silvery tips).

Skull not distinguishable from that of true *elegans*.

MEASUREMENTS.—Type: total length, 570 mm.; tail, 245; hind foot (s.u.), 67; ear (from orifice), 30; skull, condylobasal length, 64.1; basal length, 59.5; palatal length, 28.5; greatest zygomatic breadth, 37.5; least interorbital breadth, 11.9; greatest breadth of braincase, 27.7; upper tooth-row c-m², 21.5; lower tooth-row c-ms, 25.

In addition to the type we have an adult female from the same locality.

RANGE.—Probably restricted to the forestal area on the summit of Mt. d'Ambre.

REMARKS.—Archbold (1932, Amer. Mus. Novitates, No. 518, p. 1) has already described a race of *Lemur fulvus* restricted to the rain forest of the summit of Mt. d'Ambre, and in this same area there are two races of birds, *Pseudocossyphus sharpei erethronotus* and *Bernieria zosterops fulvescens*. For a description of this area see Rand, 1936, Bull. Amer. Mus. Nat. Hist., LXXII, pp. 261-263. Notes on the habitat of *G. elegans* were published in 1935, Jour. of Mammalogy, XVI, p. 94.

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NEW NEOTROPICAL TACHINIDAE (DIPTERA)

By C. H. CURRAN

This paper includes descriptions of new species belonging to *Echinopyrrhosia* Townsend and *Eudejeania* Townsend, two interesting genera occurring in mountainous areas of the American tropics. All are large robust flies of striking appearance and little is known about them. Extensive collecting will probably bring to light many more species belonging to these genera. The types are in The American Museum of Natural History.

ECHINOPYRRHOSIA TOWNSEND

This genus was established by Townsend in 1914 (Ins. Ins. Mens., II, p. 90) for three species from the Andes of Peru, with *E. alpina* as the type. The genus is readily recognized by the short palpi and hairy eyes, the palpi being more than half as long as the third antennal segment. *Cryptopalpus* Rondani has the palpi shorter. These are the only two genera of Juriniini (Epalpinæ) with pilose eyes. The propleura are bare.

TABLE OF SPECIES

- 1.—Upper lobe of the squamae brown. . . 2.
Upper lobe of the squamae grayish to yellowish, at most the border and base tinged with pale brown.
..... *alpina* Townsend.
- 2.—Legs reddish. 3.
Femora and tibiae reddish brown to black; abdomen without pollinose spots or vitta. . . *melanica* Townsend.
- 3.—Wings strikingly bicolored hyaline and brown. *pictipennis*, n. sp.
Wings almost uniformly brownish colored, the crossveins narrowly darkened, the base black. 4.
- 4.—Dorsum of third and fourth abdominal segments almost all ochraceous.
..... *browni*, n. sp.

Pollinose markings on apical segments only faintly visible.
..... *atypica* Townsend.

Echinopyrrhosia pictipennis, new species

Wings brownish with an irregular area beyond the middle and a sub-basal band cinereous hyaline. Length, 11 to 12 mm.

MALE.—Front two-thirds as wide as one eye, widening anteriorly, olivaceous, with brown reflections, the vitta reddish to blackish; bristles fine, becoming obsolete above, six or seven in each row; ocellars absent; verticals and outer verticals long and fine; hair of the head black, yellow on the lower part of the cheeks, the occipital pile yellow. Face, cheeks and occiput rich yellowish pollinose, the middle of the face paler. Cheeks about two-thirds as wide as the eye-height. Palpi slender, a little longer than the third antennal segment. Antennae black, the third segment a little longer than the second, with obtusely rounded apex; second arisal segment twice as long as wide. Eyes with grayish yellow pile.

Thorax black, yellowish-gray pollinose, the posterior calli reddish; mesonotum densely brownish pollinose, with four slender black vittae, the median pair ending a little behind the suture, the outer pair broadly interrupted. Bristles fine; acrosticals 0-1; dorsocentrals 2 or 3-4 but the anterior two pairs hairlike; normally three sternopleurals, the lower sometimes absent. Scutellum reddish in ground color and with yellowish tinged, whitish pollen, the bristles spinelike, the hair sparse.

Legs dark reddish, the tarsi black; front coxae more or less blackened, and with gray pollen.

Wings brownish, the crossvein bordered with dark brown, the apical cell (except for a brown streak in the middle), the apical fourth of the discal cell, except for a brown median stripe, and a spot behind the apical fifth of the discal cell cinereous hyaline, the base of the wing black, followed by a cinereous-hyaline band; third vein with five or six bristles basally. Squamae white, the upper lobe brown. Halteres brown.

Abdomen castaneous reddish, with whitish or yellowish-tinged pollen, the venter mostly pollinose, the dorsum with the pollen forming a pair of very large, transverse spots on the third and fourth segments, which extend narrowly over the side margins at the base; on the second seg-

ment the pale pollen is narrowly conspicuous on the base, the disc with obscure pale pollen; third and fourth segments with brown pollen separating the pale bands. Second segment with about twenty spinose discals, the fourth bristled on the apical half; second and third segments with entire rows of marginal spines, the first without dorsal bristles. Genitalia small, the posterior forceps little longer than wide, with shallowly notched tip.

FEMALE.—Front about as wide as one eye, the upper pair of frontals present but not reclinate; two pairs of orbitals; pollinose spots on the third and fourth abdominal segments deep dull yellowish.

TYPES.—Holotype, male, and paratype, male, Minza Chica, Volcano Tungurahua, Ecuador, 3750 m., April 3–15, 1939 (F. M. Brown), and allotype, female, Hacienda Talahua, Bolivar, Ecuador, 2900–3100 m., May 5, 1939 (F. M. Brown).

Echinopyrrhosia browni, new species

Wings brownish, with black base and subhyaline band beyond, the crossvein slightly darkened. Length, 11 to 11.5 mm.

MALE.—Head as in *pictipennis* but the frontal pollen is brownish olivaceous and the second antennal segment may be mostly reddish.

Thorax black in ground color, the posterior calli reddish; pleura with grayish-yellow pollen that becomes somewhat brownish above, the mesonotum with rich reddish-brown pollen and the four slender black vittae. Scutellum reddish with brownish-red pollen on the dorsum and yellowish pollinose border. The bristles of the mesonotum are as in *pictipennis* but are even finer.

Legs as in *pictipennis*. Wings as described above. Squamae white, the upper lobe brown. Halteres brown.

Abdomen rich brownish red, the third and fourth segments with very broad, entire or interrupted dull ochraceous pollinose fascia. On the venter there is considerable white pollen near the middle. The bristles are as in *pictipennis* except that those on the fourth segment occupy little more than the apical third.

TYPES.—Holotype, male, and paratype, male, Minza Chica, Volcano Tungurahua, Ecuador, 3100 m., April 26, 1939, and 3750 m., April 3–15, 1939 (F. M. Brown).

I am indebted to Mr. David G. Hall for comparing the above species with material in the U. S. National Museum.

EUDEJEANIA TOWNSEND

TOWNSEND, 1912, Proc. U. S. N. M., XLIII, p. 334.

Bombyliojeania TOWNSEND, 1931, Rev. de Ent., I, p. 352.

This genus was established by Townsend in 1912 with *E. subalpina* Townsend as the genotype. The species are large, bristly flies with subquadrate abdomen which tapers gently from the base to apex, the apex strongly concave in the middle and with large spine bunches on each side, the intermediate segments without discals but with row of long, closely set marginals. In some specimens there may be a few bristles placed in a secondary marginal row very close to the marginals but these cannot be considered discals. The hair is long. The color is usually black but the abdominal color ranges from black to castaneous or reddish brown. The propleura and eyes are bare and the bristles of the thorax are greatly reduced in number and strength: acrosticals usually absent but one sometimes present in front of the suture; dorsocentrals represented by from one to four pairs, sometimes only the prescutellar pair present, but there are often two presutural and rarely two postsutural, all long and fine. The scutellum bears stout spines in strong contrast to the weakly bristled thorax.

Townsend separated *Bombyliojeania*, with *Dejeania canescens* Macquart as the type, on the basis of the wider palpi and the presence of long, white crinkly hair on the thorax and abdomen. I can see no other differences and since the width of the palpi varies in species lacking white pile I feel the *Bombyliojeania* is unnecessary. In a specimen close to *canescens* the pale hair is as long as the bristles but scarcely crinkly and in a second species with much shorter white hair it is quite straight.

The species are very uniform in appearance and it is difficult to determine specific limits. However, in the males there is a difference in the genitalia. Other characters that may be used for the distinction of species are to be found in the general coloration, color of wing veins, color of legs, color of pollen on head and other parts and the color, length and arrangement of the hair or pile.

TABLE OF SPECIES¹

- 1.—Abdomen with black hair.....4.
Abdomen clothed with white or pale yellow pile.....2.
- 2.—Scutellum with abundant pale pile.....
.....*canescens* Macquart
Scutellum with scarcely any white pile.....3.
- 3.—Palpi black; pale pile not as long as the bristles.....*albipila*, n. sp.
Palpi reddish; pale pile longer than the bristles.....*pilosa*, n. sp.
- 4.—Palpi reddish or yellowish.....5.
Palpi brown or black.....7.
- 5.—Face luteous or reddish yellow.....6.
Face brown to blackish in ground color.....*alpina* Townsend.
- 6.—Wings pale brownish with yellow veins.....*punensis* Townsend.
Wings deeply smoky throughout....
.....*nigra* Townsend.
- 7.—Legs black, the tibiae and tarsi silvery.....
.....*argyropus* Schiner.
At least the tibiae and tarsi yellowish.....8.
- 8.—Tarsi whitish.....12.
Tarsi and tibiae yellow.....9.
- 9.—Squamae brownish, with darker border.....
.....*subalpina* Townsend.
Squamae brown to black.....10.
- 10.—Femora black on basal half or more.....
.....*femorals*, n. sp.
Femora reddish.....11.
- 11.—Second arisal segment not more than twice as long as wide.....
.....*pachecoi*, n. sp.
Second arisal segment more than three times as long as wide.....
.....*huascarayana* Townsend.
- 12.—Larger, over 17 mm.; pile of thorax long and suberect...*browni*, n. sp.
Under 14 mm.; pile rather short and subappressed...*pallipes* Macquart.

Eudejeania canescens Macquart

Dejeania canescens MACQUART, 1846, Dipt. Exot., Suppl. I, p. 143.
Bombyliojeania canescens TOWNSEND, 1931, Rev. de Ent., I, p. 352.

If Townsend has examined the type of this species there should be no doubt about

¹ *E. mexicana* and *pallipes* Desvoidy, from Mexico, are not included.

its identity since he states that there is long white hair in the scutellum. This does not agree with the two species before me, both of which have only ordinary black hair. The type came from New Granada (Colombia or Venezuela) and the species is said by Townsend to range from there to Bolivia.

Eudejeania albipila, new species

Black, the abdomen clothed with white pile that is not nearly so long as the bristles. Length, 18 mm.

MALE.—Head black and brown in ground color, with rich brownish pollen that becomes grayish white along the orbits, that on the sides of the facial depression and on the parafacials appearing dull whitish from dorsal view. Front wider than one eye, with about nine pairs of frontals and two or three in a secondary row anteriorly; parafrontals with brown pollen except along the anterior half of the orbits. Hair black; occipital pile white. Palpi black, broad, narrowing on the basal third. Antennae black, the apices of the basal segments somewhat reddish; third segment large; second arisal segment fully three times as long as wide.

Thorax dull black, with brown pollen that leaves four black vittae. Only the posterior pair of dorsocentrals present, the acrosticals absent; one sternopleural. Scutellum with black spines and black hair, a few of the hairs on the apical half broadly tipped with white.

Femora mostly black on the basal half, reddish apically, the hair black. Tibiae and tarsi orange-yellow and with yellow hair and bristles.

Wings pale brownish, more grayish anteriorly, the veins mostly brown. Squamae brown.

Abdomen dull blackish, the hair of ordinary length, black basally, white on the apical half or more.

HOLOTYPE.—Male, Minza Chica, Volcans Tungurahua, Ecuador, 3750 m., April 3–15, 1939 (F. M. Brown).

This species, because of the broad palpi, belongs with *canescens* but is readily distinguished by the shorter pale hair and partly black legs.

Eudejeania pilosa, new species

Dull black, the abdomen with very pale yellow pile which is fully as long as the bristles. Length, 17 mm.

FEMALE.—Head dark in ground color, the middle of the facial depression and epistoma brownish red; pollen cinereous yellow, cinereous on the facial depression and on the broad middle of the parafrontals when viewed from in front. Front as wide as one eye above, widening anteriorly, the parafrontals and vitta dark brown, the brown of the former bordered with obscure

brownish yellow, the frontal vitta reddish-brown pollinose from frontal view. Eight or nine pairs of frontals; no orbitals. Pile of the occiput yellow, more reddish below the cheeks. Hair black. Palpi dark reddish. Antennae blackish, the basal segments somewhat reddish; second segment of arista scarcely three times as long as wide.

Thorax dull blackish, the ploura and front of the mesonotum with dull grayish-brown pollen, that on the mesonotum forming broad, obscure vittae. Acrosticals and dorsocentrals absent except for the posterior pair of the latter. Hair black, subappressed on the dorsum. Scutellum with stout spines on the apical half or more and with erect black hair, at most a few hairs on the apex whitish.

Legs reddish, the tibiae and tarsi paler and with golden-yellow hair and bristles.

Wings brownish, the base darkened; veins mostly dark reddish. Squamae dark brown.

Abdomen dull blackish, perhaps somewhat grayish-brown pollinose, clothed with very long, pale yellowish pile, that on the fourth segment exceeding the length of the bristles.

HOLOTYPE.—Female, Maripi, Bolivia, 6200 ft., April 2.

Although close to *canescens* this species is readily distinguished by the reddish palpi.

Eudejeania alpina Townsend

TOWNSEND, 1913, *Psyche*, XX, p. 106.

I have no specimens before me at the present time but have examined the types. It is a large species, about 18 mm. long and is distinguished from the allied forms with reddish palpi by having the face brown or black in ground color. (Peru.)

Eudejeania punensis Townsend

TOWNSEND, 1913, *Psyche*, XX, p. 105.

This is a very striking species with reddish palpi and broadly yellowish bases to the wings. Its length ranges from 14 to 16 mm. Paratype material is before me. (Peru.)

Eudejeania nigra Townsend

TOWNSEND, 1912, *Proc. U. S. N. M.*, XLIII, p. 335.

This is another small species, 15 to 16 mm. in length, with reddish palpi. It may be distinguished from *punensis* by the darker, reddish-veined wings, the base not conspicuously yellowish. (Peru.)

Eudejeania argyropus Schiner

Dejeania argyropus SCHINER, 1868, *Novara Reise*, Dipt., p. 337.

Black, the tibiae and tarsi silvery; wings wholly blackish brown. Length, 15 to 17 mm.

MALE.—Head black or brown, with yellowish-brown pollen, the pollen in the antennal grooves grayish and that on the lower occiput and cheeks golden-gray. Front rich reddish brown, the parafrontals sometimes darker in the middle, the vitta deep black but with brownish-yellow pollen from frontal view; front three-fourths as wide as one eye; eight to ten pairs of frontals. Hair black, the occipital pile whitish with yellow tinge. Palpi black, broad, tapering basally. Antennae black; second arisal segment three times as long as wide.

Thorax dull black, with thin brown pollen and four dark vittae. No acrosticals; two or three presutural dorsocentrals and a single posterior pair; two sternopleurals. Hair black, rather subappressed.

Legs black, tibiae and tarsi with silvery white hair, the bristles black.

Wings blackish brown; veins brown. Squamae blackish.

Abdomen slightly shining black, with thin brown pollen beneath.

Two males, Runtun, Volcano Tungurahua, Ecuador, 3000 m., January 9, 1939 (F. M. Brown).

The black legs at once distinguish this species from any other so far described.

Eudejeania subalpina Townsend

TOWNSEND, 1912, *Proc. U. S. N. M.*, XLIII, p. 334.

I have examined the types but do not have specimens before me at the present time. The legs are reddish, with yellowish tibiae and tarsi, and the palpi are black. It seems that it may be distinguished from related forms by the brownish, black-bordered squamae. Length, about 18 mm. (Peru.)

Eudejeania femoralis, new species

Dejeania pallipes WULF, 1888 (nec Macquart), *Biol. Centr. Amer.*, Dipt., II, p. 8.

Black, the legs pale with the femora mostly blackish. Length, about 17 mm.

FEMALE.—Head black or brown in ground color; antennal grooves whitish pollinose, the middle of the face brown; parafacials brown pollinose inwardly, broadly whitish along the orbits, the pale pollen extending onto the lower part of the front. Front scarcely three-fourths as wide as one eye, opaque black, from frontal view with some obscure brown pollen, the frontal vitta with brownish-yellow pollen; seven pairs of frontals and one or two pairs of orbitals, the anterior pair divaricate (there are two orbitals on only one side). Hair black; occipital pile reddish yellow; cheeks with red-

dish-brown pollen, the lower occiput broadly grayish. Palpi black. Antennae black; the second segment almost as long as the third; second arisal segment twice as long as wide.

Thorax dull black, the pleura with brownish pollen; acrosticals 1-0; dorsocentrals 2-1; two sternopleurals.

Femora black with the apical third or less reddish; tibiae and tarsi yellow, with pale yellow hair, the bristles on the tibiae black and golden-brown.

Wings blackish brown, with brown veins. Squamae blackish.

Abdomen brownish black, somewhat shining, the hair black.

HOLOTYPE.—Female, El Volcan, Chiriqui, Panama, February 24, 1936 (W. J. Gertsch).

Eudejeania pachecoi, new species

Black, the legs yellowish; second arisal segment not twice as long as wide. Length, 16 mm.

FEMALE.—Head blackish, reddish-brown pollinose, the front dull black with just a trace of brownish pollen. Front slightly wider than one eye; seven or eight pairs of frontals and one pair of strong proclinate orbitals. Hair black, the occipital pile reddish yellow. Palpi black. Antennae black, second arisal segment scarcely twice as long as wide.

Thorax dull black; pleura with blackish-brown pollen. No acrosticals; two presutural dorsocentrals, one just behind the suture and another before the scutellum (the anterior post-sutural dorsocentral may be adventitious—there is some foreign material on one side where the bristle should be so it is impossible to tell whether it was broken off); two sternopleurals.

Femora reddish; tibiae orange, with yellow hair and bristles; tarsi yellow, with yellow hair.

Wings blackish brown, the veins mostly dark reddish. Squamae brown.

Abdomen black, with black hair.

HOLOTYPE.—Female, Guatemala (M. Pacheco).

Eudejeania huascarayana Townsend

TOWNSEND, 1914, *Ins. Ins. Mens.*, II, p. 171.

This is one of the large black species with pale legs, black palpi and reddish wing veins but the base of the wing is not pale. It was described from Peru. Before me are three specimens of each sex from Minza Chica, Volcano Tungurahua, Ecuador, 3750 m., April 3-15, 1939 (F. M. Brown), and one female, Rio San Pedro, Prov. Pichincha, Ecuador, 2400 m.,

November 10, 1938 (F. M. Brown). These agree perfectly with Townsend's description but the identification must be verified by comparison with type material.

Eudejeania browni, new species

Abdomen subshining reddish brown or pale castaneous; palpi black; tarsi whitish. Length, 17 to 18 mm.

MALE.—Head black and brownish in ground color, the pollen of the face grayish yellow laterally, becoming brown toward the ridges, the middle of the facial depression brown, the sides whitish. Front brown, the vitta black, grayish brown from frontal view; front slightly wider than one eye; eight or nine pairs of frontals. Hair black; occipital pile yellow. Palpi black. Antennae black; the second segment with a small patch of golden pollen on the upper surface near the apex; second arisal segment twice as long as wide.

Thorax rather castaneous, the mesonotum black in ground color except laterally; pollen rather dark brown, the darker vittae not strong. No acrosticals; usually two presutural dorsocentrals and the prescutellar pair. Scutellum castaneous. Hair black.

Femora reddish to brownish red, the tibiae paler and with whitish hair and black bristles; tarsi whitish, becoming yellow apically, the hair and bristles white.

Wings dark brown, the veins reddish brown. Squamae dark brown.

Abdomen reddish brown, the hair black.

TYPES.—Holotype, male, and paratypes, two males, Minza Chica, Volcano Tungurahua, Ecuador, 3750 m., April 3-15, 1939 (F. M. Brown).

Eudejeania pallipes Macquart

Dejeania pallipes MACQUART, 1843, *Dipt. Exot.*, II, pt. 3, p. 34.

This is a small species, about 14 mm. in length, originally described from Colombia. Before me is a single male from Colombia that agrees well with the original description. The tarsi are very pale yellow, with white hair and bristles while the tibiae are clothed with pale yellow hair and have black bristles. The wings are of a lighter brownish than in allied species, with slightly darker base. The antennal grooves are described by Macquart as whitish, but the head has been wet in my specimen so this point cannot be checked.

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THE GENUS *ARUGISA* IN THE UNITED STATES, WITH THE DESCRIPTION OF A NEW SPECIES (LEPIDOPTERA: PHALAENIDAE)

By A. GLENN RICHARDS, JR.¹

The genus *Arugisa* Walker is represented in the United States by only two species, one described herein as new. However, several differences exist between these two species. Because of these differences the name *Diallagma* Smith, placed in synonymy by Hampson, is reinstated as of subgeneric rank.

Arugisa WALKER, 1865, Cat. Br. Mus., XXXIII, p. 1023 (type: *aliena* Walker, sole species).—HAMPSON, 1926, Descr. N. Gen. and Sp. Lepid. Phal. Noct., p. 241. McDUNNOUGH, 1938, Checklist, p. 126.

Poena DRUCE, 1891, Biol. Centr.-Amer., Het., I, p. 483 (type: *porrectalis* Druce).²—SCHLUS, 1916, Proc. U. S. Natl. Mus., L, pp. 363-364.

Diallagma SMITH, 1900, Proc. U. S. Natl. Mus., XXII, p. 483 (type: *lutea* Smith, sole species, synonym of *Acrobasis latiorella* Walker).—DYAR, 1902, List. N. A. Lepid., U. S. Natl. Mus., Bull. 52, p. 207.—BARNES AND McDUNNOUGH, 1917, Checklist, p. 88.

The closest relatives of *Arugisa* are neotropical genera not occurring in the United States, namely, *Aglaonice* Möschler, *Carillade* Schaus, *Cladenia* Möschler, etc. Characters and a key for the separation of these are given by Schaus (1916). Superficially the two North American species (but not the tropical species) look nearest the genus *Metalectra* Hübner, but structurally they are closer to *Eucalyptia* Morrison. From both of these genera the two North American species of *Arugisa* may be separated by veins 3 and 4 (M_3 and Cu_1) of the hind wing being long stalked; other characters are shown by the palpi (Figs. 2 and 5), the small prothoracic and

metathoracic tufts and the genitalia. The tropical species also differ in the elaborate tufting and fringing of the palpi of both sexes and the extensive tufting of the legs of the males. See Schaus (*loc. cit.*) for list of characters of *Poena*.

MALE GENITALIA (based on *porrectalis*, *antiope*, *watsoni*, and *latiorella*).—Uncus long with tuft of setae from dorso-lateral margin near tip. Juxta (annellus) large, sclerotized bars on lower side articulating with harpes. Harpes of moderate length, well sclerotized for entire length except on inner side; ampullae³ long and those of the two harpes usually somewhat different; inner ventral margin with curved setose lobe just beyond ampulla; transtillae present. Aedeagus large, curved; vesica armed with microtrichiae plus sclerotized areas bearing heavier spines; no macrochaetae.

FEMALE GENITALIA (based on same 4 species).—Ovipositor short. Apophyses of segment VIII rather short. Sternite VII roundly triangular, projecting over vulva; pleural membrane of this segment infolded and enclosing a mass of special scales. Ductus bursae moderately sclerotized and ridged, near vulva supported by a heavy ventral sclerite. Bursa copulatrix sclerotized in region of entrance of ductus

³ In previous papers of the *Melipotis-Drasteria* series I have referred to such dorso-basal prongs as clavi but questioned same. The clavus is supposed to be a part of the sacculus, whereas these lobes have no connection to the sacculus but an intimate connection to the transtillae, the clasper (when present, compare *Drasteria* sp.) and the line of sclerotization between these two. Pierce might prefer to call this a basal clasper since it has such a swollen base, but I use ampulla because it may occur (e.g., *Drasteria*) with a conventional clasper. Perhaps a new term would be preferable but at least "ampulla" seems to be of the correct association. In the *Plusiinae* a slim basal lobe is present but in this subfamily it is associated with the sacculus or arising from membrane near the sacculus; in this case it is probably correctly called clavus (as Pierce does call it. See Genit. Br. Noctuidae).

¹ Zoological Laboratory, University of Pennsylvania.

² Genotype designated as *Hypena porrectalis* Guenée which is not the same as *P. porrectalis* Druce. Hampson and Schaus, following usual English custom, cite *porrectalis* Druce as genotype; another school of nomenclaturists would insist on the Guenée species as genotype. In this case the argument is only academic, as the name *Poena* is a synonym.

bursae; with row of heavy spines which cross the ventral side and then around the left side and diagonally across the dorsal side, becoming smaller on dorsal side; bursa anterior to this row of spines membranous and uniformly covered with microtrichiae. Ductus seminalis arising from bursa near the ductus bursae.

The differences between the two subgenera may be summarized as follows:

Palpi porrect or only slightly obliquely ascending; first segment of palpus heavily fringed or tufted with hair below (hiding tongue); legs of male tufted and fringed.

.....Subgenus *Arugisa*.

Palpi obliquely ascending; first segment only lightly fringed with hair below (not hiding tongue); legs of male normal and closely scaled.Subgenus *Diallagma*.

The subgenus *Diallagma* includes the single species *laticollis* Walker. The subgenus *Arugisa* will include *porrectalis* and *watsoni* which have been studied genitally and also *pilosa* Warren, *aliena* Walker and several other species examined externally at the U. S. National Museum. Another species studied (including male and female genitalia), namely, *antiochae* Druce, has somewhat different palpal and genital structures, and may need a separate subgenus.

Arugisa (Arugisa) watsoni, new species

Figures 1-4

Head and palpi as figured. In male fore coxae with long light-colored hairs; fore femora with heavy tuft of blackish scales, the tuft about half as long as the tibia; fore tibiae with heavy fringe of light scales; fore metatarsus with black tuft on inner side; middle and hind femora and tibiae heavily fringed with light-colored scales. In female legs normal and smoothly scaled except for some long hairs on hind femora.

Head almost black on vertex, brown around edges of vertex and on genae and frons except for black patch below antennae; maculation of palpi on outer side as in Fig. 2, lighter on inner side; antennae dark, ringed with lighter. Thorax brown, small prothoracic tuft of dark brown-black scales tipped with whitish; patagia brown with some darker scales; small metathoracic tuft of black scales tipped with white. Abdomen brown with some darker scales. Legs light brown with some darker scales, the tarsi darker and ringed with whitish; tufts in male as above.

Fore wing (Fig. 1) ochreous suffused with red-brown and irrorated with some black; black

basal dash at costa to cell; t. a. line blackish, slightly oblique, angled outward on radial and cubital stems; a small black spot in cell just beyond t. a. line (in holotype connected to antemedial line by black suffusion and with it forming a dark bar across cell, in other specimens separate); no median line or shade; reniform indicated by a small dark point, obsolescent in some specimens; t. p. line dark, single, outwardly oblique or excurved to vein 7 (R_5), faintly waved and erect to vein 4 (M_2), incurved to submedian fold, excurved across anal vein and then incurved to inner margin; three light spots on costa between (but not counting) t. p. and subterminal lines; subterminal line a lighter brown defined by preceding darker suffusion and the slightly darker terminal area (subterminal line partly obsolescent in some specimens including holotype), slightly angled out on vein 7, incurved in discal fold, excurved to vein 4, incurved in submedian fold and excurved across anal vein with slight incurving to inner margin; terminal series of black points between the veins; cilia ochreous suffused with brown, lighter at base and tips. Hind wing uniform brown with faint terminal line. Underside of fore wing ochreous suffused with brown, costa lighter; faint postmedial and subterminal lines; terminal area lighter; faint terminal line forming spots between the veins; cilia as above. Underside of hind wing lighter than above; dark discal spot; curved postmedial line; faint dark subterminal line, and dark terminal line forming spots between the veins.

EXPANSE.—21-23 mm.

MALE GENITALIA (2 slides including holotype).—As figured (Fig. 3) but the lobe on the right harpe is curved under in its natural position, if straightened out this lobe would appear as the one shown on the left harpe. The points of the tip of the ampullae normally face posteriorly but have been turned sideward in mounting to show greatest profile. Setae omitted from harpes except for those on the small lobes (setae similar to those shown on figure of *laticollis*). Sclerites and microtrichiae in aedeagus all on vesica except few minute points on the ventral side near the tip.

FEMALE GENITALIA (3 slides including allotype).—As figured (Fig. 4); sclerites of segment VII shown by dotted outline only. Bursa covered with microtrichiae anterior to the row of spines.

HOLOTYPE.—♂. Florida, no further data. (In American Museum of Natural History.)

ALLOTYPE.—♀. Everglade, Florida. April 8, 1912. (In American Museum of Natural History.)

PARATYPES.—1 ♀; Miami, Florida, no date. (Ex Schaus Collection, in U. S. National Museum.) 2 ♂, 1 ♀, Florida,

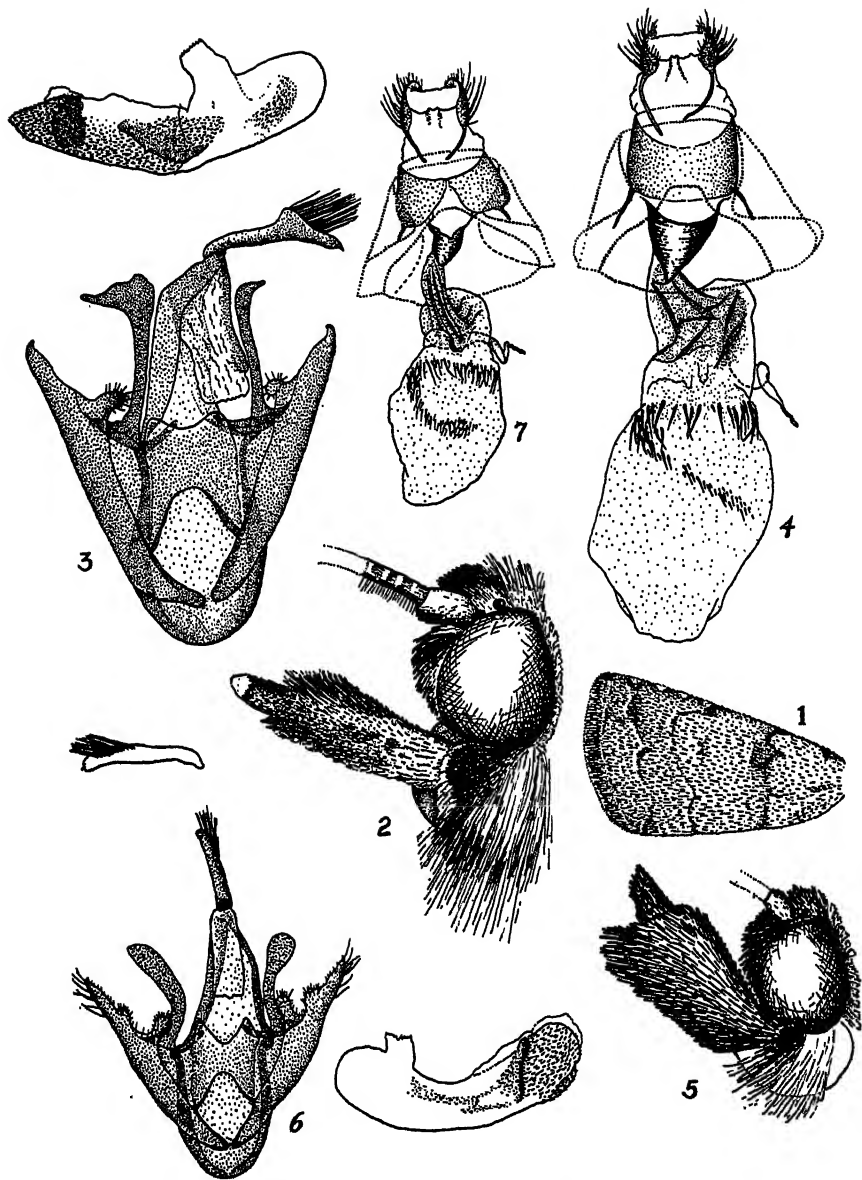


Fig. 1. *Arugisa (Arugisa) watsoni*, n. sp. Holotype ♂. Free-hand sketch of maculation of fore wing.

Fig. 2. *A. (A.) watsoni*, n. sp. Paratype ♂. Lateral view of head and palpi (female same).

Fig. 3. *A. (A.) watsoni*, n. sp. Paratype ♂. Genitalia, the aedeagus drawn above at same magnification.

Fig. 4. *A. (A.) watsoni*, n. sp. Allotype ♀. Genitalia, ventral view; sclerites of segment VII in dotted outline.

Fig. 5. *Arugisa (Diallagma) latiorella* (Walker). Lateral view of head and palpi of female (male same).

Fig. 6. *A. (D.) latiorella* (Walker). Male genitalia; lateral view of uncus above and of aedeagus alongside; all at same magnification. Specimen from Athens, Georgia, August, 1927 (A. G. Richards, Jr., coll.). Slide compared with that of cotype of *lutea* Smith in Amer. Mus. Nat. Hist.

Fig. 7. *A. (D.) latiorella* (Walker). Female genitalia, ventral view; sclerites of segment VII in dotted outline. Specimen from Florida.

no further data. (Ex Schaus Collection, in U. S. National Museum.)

As neither of the females bearing definite locality data is in perfect condition, the best male has been chosen as holotype. The two localities, Everglade and Miami, are both located at the southern end of Florida, and it seems quite likely that the species is restricted to the tropical zone at the extreme southern end of this state.

This species is unlike any of those in the neotropical collections in the U. S. National Museum, and seems to be close only to *albipuncta* Hampson (1926, Descr. N. Gen. and Sp. Lepid. Phal. Noct., p. 242) which is known only from the unique female type from Jamaica. *Watsoni* agrees fairly well with most of the pattern description of *albipuncta* but differs strikingly in the terminal line being only a series of black points between the veins and certainly not "a fine waved blackish terminal line forming small white spots in the interspaces with slight dentate white marks before them." Also in *watsoni* the black spot in the cell is not defined by white, the postmedial line (t. p. line) is single and below the submedian fold is excurved across the anal vein and then incurved to the inner margin.

In the North American fauna *watsoni* is naturally closest to *latiorella* Walker in maculation, lacking however the extensive dark suffusion before the subterminal line, and being larger and browner, and having quite different palpi and genitalia.

Named in honor of Mr. Frank E. Watson who has recently retired after many years in charge of the lepidopterological collections of the American Museum.

Arugisa (*Diallagma*) *latiorella* (Walker)

Acrobasis latiorella WALKER, 1863, Cat. Br. Mus., XXVII, p. 29. Type locality: Florida. Type: in British Museum.

Diallagma lutea SMITH, 1900, Proc. U. S. Natl. Mus., XXII, pp. 483-484. Type locality: Charlotte Harbor, Florida (Mrs. Slosson). Type: in U. S. National Museum, cotype in Amer. Mus. Nat. Hist.

Determinations based on colored drawing of Walker's type in the Barnes Collection (U. S. Natl. Mus.) and study of Smith's types, including male genitalia of cotype, in American Museum.

The maculation of this species is similar to that of *watsoni* (Fig. 1) but the more yellow-brown ground color and the extensive suffusion before the transverse lines gives it a different appearance. The poor sketch in Holland's Moth Book (Fig. 153, p. 245) is not particularly useful but is the only published figure. The almost solidly dark gray or black head and palpi and the scaling of the same are diagnostic (Fig. 5).

EXPANSE.—18-22 mm.

MALE GENITALIA (3 slides studied, including cotype).—As figured (Fig. 6). The heavy spinose bar in the aedeagus is on the vesica. The setose lobe of the sacculus is normally curved around the inner face of the harpe. The two ampullae are really alike, the seeming difference in the drawing is due to slight difference in positioning in mounting the slide.

FEMALE GENITALIA (2 slides studied).—As figured (Fig. 7), but the heavy row of spines in the bursa copulatrix passes around on the right side to about the mid-dorsal line (cannot be shown as directly above row on ventral side). Bursa anterior to this row of spines covered with barely visible microtrichia.

DISTRIBUTION.—Texas, Alabama, Florida, Georgia, North Carolina, and Virginia. Fairfax, Virginia (F. H. Benjamin), is the most northern record. Not known from Mexico or the West Indies.

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A NEW SPECIES OF *METALECTRA* FROM FLORIDA (LEPIDOPTERA: PHALAENIDAE)

By A. GLENN RICHARDS, JR.¹

Metalectra albilinea, new species

Head dark slate gray above, few light brown and pinkish scales in middle of frons or light patch on frons; antennae dark gray with slightly lighter bands; palpi with second segment dark gray with some light scales, third segment whitish with black band across middle. Thorax dark slate gray. Legs gray to black, tarsi banded with white; middle tibiae of male with fringe of scales on outer side. Wings reddish brown suffused with dark gray; black basal dash defined on outer side by white which expands into white spot on costa; t. a. line white defined on outer side by row of black scales, almost erect, in some specimens outwardly produced on radial sector, incurved across cell and excurved above and below anal vein; orbicular a faint gray spot or obsolescent; reniform faintly indicated as darker dash on outer edge of median line; median line erect from costa to cell, excurved to reniform then erect to inner margin with slight inward angulation in submedian fold and excurvation across anal vein; area between reniform and t. p. line contrastingly light reddish brown; t. p. line black, outwardly defined by white scales especially at costa where there is a white point, outwardly oblique to vein 6 (M_1), erect to vein 4 (M_2), then incurved to inner margin, produced to outwardly directed points on veins 1 to 6 (M_1 to A); two white points on costa between t. p. and subterminal lines; subterminal line pure white defined by preceding dark gray-brown subterminal area and succeeding dark brown terminal area, somewhat produced on veins 7 (R_5) and 4 (M_2) and incurved in discal fold and below vein 4; black terminal line expanding into triangles between the veins, on outer side defined by white or whitish line through base of cilia, the white line being broader opposite the black spots of the terminal line; cilia beyond basal line dark gray with some pinkish scales. Hind wing gray with brownish tint, trace of light subterminal line especially near inner margin; dark gray terminal line, broader between the veins; cilia dark with light line through their bases. Beneath fore wing ochreous suffused with brown, trace of t. a. and t. p. lines at costa; faint light subterminal line; ter-

minial area lighter; black terminal line and cilia as above; hind wing as above but lighter.

EXPANSE.—17 mm.

MALE GENITALIA (2 slides, Figs. 1-3) as figured but harpes and claspers of the two sides alike; the claspers normally project posteriorly, and in Figure 1 the clasper of the right harpe has been turned completely to give a mesal view while the one of the left harpe projects slightly posteriorly and is accordingly of somewhat different outline. Figure 2 is a truly mesal view of the left harpe showing normal maximal outline of both clasper and semi-membranous apical half of harpe (cucullus). Figure 3 shows the same in more ventral view; this aspect though more readily obtained in preparing a mount does not show adequately the needed diagnostic characters. Diagnostic characters are the shape of the clasper and cucullus (Fig. 2) and the simple vesica. The closest North American species, *miserulata* Grote, has a slightly different clasper and a larger cucullus which is distinctly broader at the middle and tapering to a rounded apex.

Female genitalia (2 slides, Fig. 4) as figured. Spines on the dorsal side of the bursa copulatrix shown in stipple; that part of the bursa anterior to this row of spines covered with microtrichiae which become smaller at the anterior end. These structures are extremely close to those of *miserulata* Grote, differing principally in the scale pouch areas at the latero-anterior corners of segment VIII (in *miserulata* this area is rather well developed and has an anteriorly projecting evagination where *albilinea* has only a slight ridge—indicated in Figure 4 by arrow).

HOLOTYPE.—♂, S. Jacksonville, Florida. April 2, 1922. Thos. J. Hallinan. A.M.N.H. Acc. No. 23983. (In American Museum of Natural History.)

ALLOTYPE.—♀, Florida, no further data. (Henry Edwards Collection No. 12430. (In American Museum of Natural History.)

PARATYPES.—1 ♂, 1 ♀, Florida, no further data. (Ex Schaus Collection, in U. S. National Museum.)

In both appearance and markings this

¹ Zoological Laboratory, University of Pennsylvania.

new species is most similar among North American species to *misserulata* Grote from which it may be readily recognized by its smaller size, red-brown color, less distinct black lines, PURE WHITE SUBTERMINAL LINE, and shape of the cucullus of the male genitalia. None of the species in the neotropical collections of the U S National Museum is close to *albilinea*. Of the tropical species, *albilinea* seems to come

closest to the description of *volescens* Hampson (1926, Descr N Gen and Sp Lepid Phal Noct, pp 282-283) from Panama (type locality) and Costa Rica from this species *albilinea* differs in having no whitish on the outer side of the reniform, area between reniform and t p line contrastingly lighter, no dark brown patch beyond the subterminal line and some other pattern details

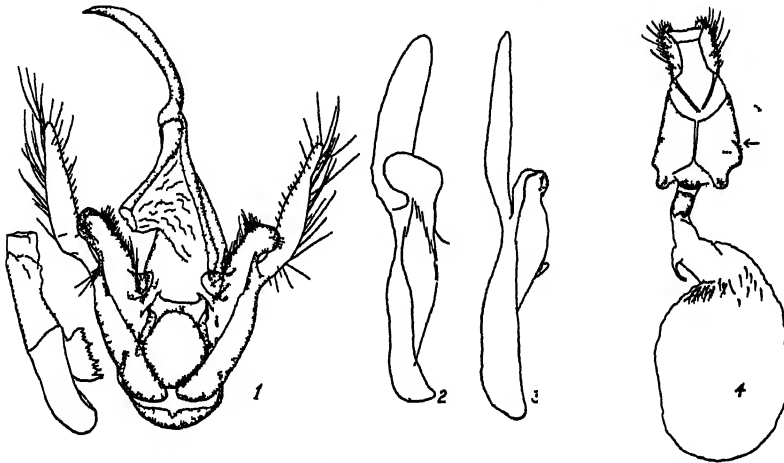


Fig 1 *Metalectra albilinea* n sp Male genitalia of paratype Aedeagus drawn alongside at same magnification
 Fig 2 Truly mesal view of left harpe of same specimen Slightly higher magnification
 Fig 3 Ventral view of left harpe of holotype
 Fig 4 Ventral view of female genitalia of paratype Outline of segment VII shown by dotted lines

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XLIV¹

NOTES ON THE GENUS *LALAGE* BOIE

By ERNST MAYR AND S. DILLON RIPLEY

This genus is an important member of the Polynesian avifauna, even though it is absent from eastern Polynesia and from Micronesia. In the central Polynesian Islands, however, and in southern Melanesia, it is found not only on the big islands, but also on many of the outlying small islands in numerous well-defined races. The last treatment of the genus, that by Mathews in the "Syst. Av. Austr." (1930), pp. 546-548, is very unsatisfactory, because it fails to reveal the true relationships of the many described forms. It became necessary during the study of the Polynesian material to go beyond the borders of this zoogeographical district and to include in our work a cursory study of the Papuan, Australian, and Malayan forms. As the work proceeded it became clear, on the one hand, that a great many of our conclusions were at variance with the currently accepted views on the relationships of the species of this genus and, on the other hand, that the genus presented unusually favorable material for the elucidation of speciation phenomena and of the zoogeographical history of the area. It was, therefore, decided by us to devote more space to the extralimital forms and to the general discussion than has been customary in the preceding papers of this series.

GENERIC CHARACTERIZATION

It is usually difficult to define Passerine genera by morphological characters. In the family Campephagidae this is particu-

larly true, as can be seen by looking at the characters used in the "Cat. Birds Brit. Mus." (vol. 4, pp. 7-8), to identify the various genera. Still, a typical *Lalage*, such as *nigra*, *tricolor*, *leucomela*, or *maculosa*, is recognizable at a glance. The difficulty is rather where to draw the line between *Lalage* and the genera related to it.

According to the Cat. Birds (*loc. cit.*), *Edolisoma* differs from *Lalage* by having the culmen as long as the tarsus; *Lalage* has it shorter than the tarsus. This, unfortunately, is not correct. In *Edolisoma*, as well as in *Lalage*, the culmen is generally shorter than the tarsus. In fact, so far as we could determine, there are no clear-cut characters available to separate the two genera. However, it is possible to define the genus *Lalage* by a combination of morphological and color characters as follows:

Lalage comprises a number of small Campephagidae with rather short and slender bills and without lipochroms and special skin and feather structures; sexual dimorphism is usually well developed; the tail is medium long (70-95 per cent of the wing); there are generally prominent white wing-bars, a light rump, and often a white supercilium; the upper parts are brownish, gray, or black; the under parts are white with or without dark bars and a buffy or rufous wash.

On the basis of this definition the genus would include in addition to the *nigra*, *aurea*, and *leucopygia* groups (as defined below) the Philippine species *melanoleuca*, a discussion of which is beyond the scope of the present paper. The species *fimbriata*, *sykesi*, *melaschista*, and *melanopectus*, however, are not covered by the above-given definition, and it will be better to refer them to the genus *Volvocivora*.

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 488, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, 977, 986, 1006, 1007, 1056, 1057, and 1091.

Whether or not there are good characters by which to separate *Volvocivora* from *Edolisoma* must be shown by further studies.

Several species have at one time or another been included erroneously within the genus *Lalage*. Among these are *Turdus pacificus* Gmelin, discussed at a later point in the text, and *Volvocivora insperata* Finsch included in the genus *Lalage* in the "Cat. Birds," vol. 4, p. 103, and other reference books. This species is a geographical representative of *Edolisoma tenuirostre* as pointed out by Mayr (Ornith. Monatsber., 1939, p. 126). Other species listed in the Cat. Birds as *Lalage*, but no longer considered to belong to that genus, are: *banksiana* Gray (= *Neolalage*), *rufiventris* (= *Coquus typicus*), *newtoni* (= *Coquus newtoni*), and *monacha* (= *Edolisoma tenuirostre monachum*).

GENERIC SYNONYMS

Lalage BOIE, 1826, Isis, col. 973.—Type (by monotypy): *Turdus orientalis* Gmelin = *Turdus niger* Forster.

Erucivora SWAINSON, 1832, Faun. Bor.-Amer. Birds, p. 483.—Type (by original designation): *Turdus orientalis* Gmelin.

Symmorphus GOULD, 1838, Synops. Birds Austr., pt. IV, App., p. 3.—Type (by monotypy): *Symmorphus leucopygus* Gould.

Pseudolalage BLYTH, 1861, Journ. As. Soc. Ben., XXX, p. 97.—Type (by monotypy): *Lalage melanoleuca* Blyth.

Diaphoropterus OBERHOLSER, 1899, Proc. Acad. Phila., p. 214.—Type (by original designation): *Symmorphus leucopygus* Gould, new name for *Symmorphus* Gould, 1838, not Westmael, 1833, Mon. Odyn. Belg.

Karua MATHEWS, 1913, Austral. Av. Rec., II, p. 59.—Type (by original designation): *Campephaga leucomela* Vigors and Horsfield.

Perissolalage OBERHOLSER, 1917, Proc. U. S. Nat. Mus., 54, p. 182.—Type (by monotypy): *Perissolalage chalepa* Oberholser.

Oscarornis MATHEWS, 1928, Novit. Zool., 34, p. 372.—Type (by original designation): *Lalage sharpei* Rothschild.

Of the listed names one (*Symmorphus*) is preoccupied, while another (*Erucivora*) is a strict synonym (identical genotype) of an older name. The others deserve some discussion:

The genus *Neolalage* Mathews, 1928, included among the *Campephagidae* in Mathews' Check-List (Syst. Avium Austr., II, 1, p. 551), has been proved by Mayr

(Amer. Mus. Novitates, 1933, No. 665) to belong to the *Muscicapidae*. *Diaphoropterus* will be discussed on a later page, as will *Oscarornis*. The genus *Karua* was established by Mathews on the basis of a smaller bill and different wing formation (Mathews, loc. cit.). It was also stated that in the male breeding plumage there is no white wing-bar. Comparison of specimens in the American Museum's collection does not bear out these differences. The bill is not smaller, the wing formula is not appreciably different, and no specimens were seen lacking the white wing-bar. It is obvious, on the other hand, that the species of "*Karua*" are closely related to the *aurea* group. Their size and proportions are similar and there are no color patterns that can be looked upon as fundamentally different.

Pseudolalage Blyth, based on *Lalage melanoleuca*, has been rejected with good reason by all recent authors and, therefore, requires no further discussion. It was based on supposed differences in the structure of the feathers of the rump. The generic diagnosis of *Perissolalage* Oberholser (Proc. U. S. Nat. Mus., 1917, vol. 54, p. 182) gives the specific characters of *Lalage sueurii* as compared to *Lalage nigra*, but none of the differences between these two closely related species are of generic importance.

The genus *Campochaera* (type *sloetii*) is probably a specialized offshoot of the ancestral *Lalage* stock.

SYNOPSIS OF THE SPECIES OF *Lalage*

In view of the many conflicting statements of the recently published lists of the genus (Mathews, Chasen, etc.), and in view of the different conclusions at which we have arrived in many instances, it will greatly facilitate the understanding of the subsequent discussions if we preface them by a short outline of the classification of the species and subspecies of this genus.

Lalage nigra group

1.—*Lalage nigra*

(a) *davisoni* Kloss.

RANGE.—Nicobars.

(b) *nigra* Forster, with *brunnescens* Baker, 1923 (Selangor), and *empheris* Oberholser, 1912 (Nias), as synonyms.

RANGE.—Malay Peninsula, Sumatra, Nias, western Java and Karimon-Java Islands.

(c) *chilensis* Meyen with *schisticeps* Neumann, 1919, and *mitifica* Bangs, 1922, as synonyms.

RANGE.—Borneo (and islands), Philippines.

(d) *leucopygialis* Walden, 1872.

RANGE.—Celebes, Peling, Banggai, Sula Isls.

2.—*Lalage sueurii*

(a) *sueurii* Vieillot, 1818—synonyms *timoriensis* Müller, 1843, *riedeli* Meyer, 1884 (Kisser I.), *celebensis* Meyer, 1884 (Celebes), *chalepa* Oberholser, 1917 (Solombo Besar).

RANGE.—Western Java, Lesser Sunda Isls. from Bali to Timor, south Celebes (Makassar), islands of Flores Sea.

(b) *tricolor* Swainson, 1825.

RANGE.—Northern Australia (for a more detailed treatment see Mayr, 1940, Emu, 40, pp. 111-115).

Lalage leucopyga group

Lalage leucopyga Gould, 1838 (see p. 15)

RANGE.—Islands east of Australia from Norfolk I. north to San Cristobal, eastern Solomon Islands.

Lalage aurea group

1.—*Lalage aurea* Temminck, Dec., 1825

RANGE.—Northern Moluccas (Batjan, Ternate, Halmahera and Morotai).

2.—*Lalage atrovirens*

(a) *moesta* Sclater, 1883—Tenimber.

RANGE.—Tenimber Isls.

(b) *atrovirens* Gray, 1862—Misol.

RANGE.—Western Papuan Islands (Misol, Salawati), western New Guinea (Vogelkop), and northern New Guinea from Geelvink Bay eastward to Astrolabe Bay and the Ramu River.

(c) *leucoptera* Schlegel, 1871—Biak.

RANGE.—Biak I., Geelvink Bay.

3.—*Lalage leucomela* Vigors and Horsfield

(a-c) *leucomela* Vigors and Horsfield (before Feb. 17, 1827) (+ subsp.) (treated

in detail in Emu, 40 (1940), p. 115-117), and following races of the Papuan region: *keyensis* (Key Isls.), *polygrammica* (Aru Isls., south and east New Guinea), *obscurior* (D'Entrecasteaux Arch.), *trobriandi* (Trobriand Isls.), *pallescens* (Louisiade Arch.), *falsa* (Rook, New Britain, Duke of York), *karu* (New Ireland), *ottomeyeri* (Lihir), *albidior* (New Hanover), and *conjuncta* (St. Matthias I.).

4.—*Lalage maculosa* (see below)

5.—*Lalage sharpei* (see below)

HISTORY OF THE GENUS *Lalage*

An examination of the genus *Lalage*, as a whole, brings us to the conclusion that the origin of the genus must be looked for somewhere within the borders of the Oriental region. After having spread to the Papuan region the genus split up into several groups of which the *nigra*, *aurea*, and *leucopyga* groups have remained largely representative until the present time. Only in Australia and in the central New Hebrides are there cases of overlapping between members of these different groups. In each case the name given by us to the group has been taken from the first named species. There are various species in the *nigra* and *aurea* groups, each of which is, however, more closely related to the rest of the group than to any outside species.

nigra group

The two species making up this group, *nigra* and *sueurii*, differ from any of the species of the *aurea* group by the following characters:

MALE.—The rump patch is more prominent, larger and better differentiated from the back. There is no real indication of barring on the white (sometimes grayish) of the under parts. There is no tendency to a rufous or buffy coloration on the under parts. The wing is characterized by heavy white edging to the wing-coverts, extending through the lesser wing-coverts in one species, whereas the *aurea* group has this character rather less pronounced and the feathers of the outer greater wing-coverts are tipped, never edged, with white.

FEMALE.—Differs from that of the *aurea* group by the coloration of the rump which is shaded differently from the back rather than being somewhat abrupt and patchy; upper tail-coverts only indistinctly barred and tipped; under parts much more finely barred when barring occurs.

It has been customary to divide the *nigra* group into three species: *nigra* (with *davisoni*, *nigra*, *chilensis*, and *sueurii*), *leucopygialis*, and *tricolor*. Our researches indicate that there are only two groups: *nigra* (with *davisoni*, *chilensis*, and *leucopygialis*) and *sueurii* (with *tricolor*). These two groups are very similar and would probably be united into one species if they were strictly representative. It has been found, however, that the two species occur together in the Makassar district of southwestern Celebes without any signs of hybridization. The only other place where the two species meet is central Java, but, unfortunately, nothing is known about their relations in that region. Do they intergrade imperceptibly, do they hybridize, do they represent each other ecologically, or do they live side by side like good species? These are some of the questions that the field ornithologists in Java should study.

The superspecies *nigra* broke, apparently rather early in the Pleistocene, into a western (Malaysian) and an eastern group which must have been separated for a considerable period. The fact that the two neighboring races of the two groups (*nigra nigra* and *sueurii sueurii*) are the most similar, indicates that the separation occurred a considerable time after subspeciation within the groups had already started. It is probable that no birds of these species occurred on Java for a good part of the Pleistocene and that this is the reason for the decided gap in the characters.

If we compare the forms of the two species which now occur in central Java in immediately neighboring districts, we find that *sueurii* differs from *nigra* as follows:

Bill longer and more slender, culmen straighter; tail longer, wing more pointed; second primary longer than sixth (in *nigra* generally shorter than sixth); first primary very much shorter.

Adult male: Under parts pure white, not washed with gray; superciliary much less pronounced, often almost absent; gloss of upper parts (in fresh plumage) greenish, not bluish; bend of wing and lesser wing-coverts white, not black; greater upper wing-coverts white on both webs; much less white on tip of tail-feathers, white on central tail-feathers a narrow margin surrounding the entire feather, not a well-defined

tip; pale rump region reaching much higher up on the back.

Adult female: Showing much stronger sexual dimorphism, being much more rufous brown above and having the pale edges of wing-feathers and wing-coverts strongly washed with buff, not white; barring of breast and flanks very indistinct.

The majority of the points by which *nigra nigra* is characterized are also found in the other races of this species. This is important in connection with *leucopygialis* (Celebes). Stresemann in his recent treatise on the birds of Celebes states (1940, Journ. f. Ornith., 88, p. 127) that *leucopygialis* is a well-defined, isolated species of doubtful relationship and point of origin. It seems to us that he has been led astray by some of the specializations (white rump, black cap of female) which this species has evolved during a long period of isolation on Celebes. On the other hand, it has all the basic specific characters of *nigra* and what is still more important, it is linked up with *nigra nigra* by the exactly intermediate *chilensis* from the Philippines. It is now clear that *leucopygialis* has reached the Celebes Archipelago via the Philippine Islands, and has evolved there into the final step of the cline *nigra-chilensis-leucopygialis*.

L. sueurii was presumably isolated on the Lesser Sunda Islands, from where it spread into Australia and developed into the very similar form *tricolor*. At a fairly recent date it entered a rather aggressive period of colonization and settled in eastern Java, on some of the islands of the Java Sea, and in the southern peninsula of Celebes where it now lives side by side with *leucopygialis*.

aurea group

This group divides into five species, *aurea*, *atrovirens*, *leucomela*, *maculosa*, and *sharpai*, ranging from Halmahera to Samoa. Certain characters set off this group from either of the others.

MALE.—The rump patch is more reduced than in either of the other groups and the upper tail-coverts are more prominently barred and tipped. The white area on the wings is smaller and on the outer greater wing-coverts occurs in tips rather than in edging. There is a tendency for a rufous coloration to appear in the under parts in contrast to the buffy coloration of some

members of the other groups. Barring, when it occurs, is coarse and plentiful, particularly in the females. The tail tends to average shorter; the relative tail-length varies from 64 to 85 per cent of the wing-length, while in the *nigra* group it varies from 77 to 85, and in the *leucopygia* group from 83 to 97.

The species *aurea* is sharply differentiated from the other species of the group by solid rufous under parts. Disregarding this character, however, it is at once seen that in size, shape, and in the rest of its coloration it is closely related to *atrovirens*. *L. atrovirens* which occupies northern and western New Guinea lacks the rufous under parts; it has two races on two neighboring groups of islands (*moesta* and *leucoptera*).

The representative species in southern and eastern New Guinea is (*karu* =) *leucomela*, which, like *aurea*, has a good deal of rufous on the under parts. In one race (*conjuncta*) this rufous coloration is carried over the whole of the belly and vent making it appear at first closest to *aurea*, but further examination reveals that *conjuncta* is merely the last step in a discontinuous cline of races of *leucomela* extending up through the Bismarck Archipelago. The species has also settled in Northern Territory (Australia) arriving there via Aru and Kei Islands, and in eastern Australia via south New Guinea and Cape York. In the east it is found as far as the Louisiade Archipelago.

Lalage maculosa

To the east of the Louisiades there is a considerable gap in the range of the *aurea* group. It is completely absent from the Solomon Islands, but is found again in the central New Hebrides and Santa Cruz Islands and reaches from there eastward as far as Samoa. The two species, *maculosa* and *sharpei*, which are found in this area, are most closely related to one another but both are obviously eastern descendants of the *aurea* group.

It is probable that the original stock of *maculosa-sharpei* came directly from the New Guinea area, because the *aurea* group is absent from the Solomon Islands, and there are only slightly differentiated "recent" forms in the Bismarck Archipelago, the Louisiades, and in Australia. The two

New Guinea species *atrovirens* and *leucomela* are strictly representative, and it is impossible to decide which is closer to *maculosa*.

The first islands to be settled were evidently the large islands of the Fiji group and of Samoa (Upolu, Savaii). This assumption is not only in harmony with our general knowledge of the settlement of Polynesian Islands (Mayr, 1941), but it is confirmed by the high degree of specialization reached by the Samoan species *sharpei*. This development was retrogressive (see below), while, on the other hand, the *maculosa* and *vanikorensis* groups split off the Fijian *woodi* assemblage and developed unbarred plumages in the male and sometimes even in the female. Eventually, a second wave (*maculosa*) reached Samoa (via Tonga Isls.), but did not hybridize with *sharpei*, because the latter had already differentiated too far and had lost sexual affinity. There are now two good species of *Lalage* on Upolu and Savaii, but, unfortunately, nothing is known about their ecology. Judging by the analogy of similar cases one would expect that the earlier settler (*sharpei*) is more a forest and mountain bird and the recent settler (*maculosa*) more a bird of the open country in the lowlands.

Widespread (though never quite universal) characters of the forms of *maculosa* are: small degree of sexual dimorphism, in connection with a rather masculine female plumage; reduced barring of the under parts, particularly in the males; pronounced white pattern on wing, head (superciliary, etc.), and back; lack of buffy wash on under parts, at least in the males; heavy bill and short tail.

The eastern *maculosa* forms

The *maculosa* group is found on Samoa, the Tonga Islands, eastern Fiji (Lau Archipelago), and some of the isolated islands (Niue, Futuna, Keppel, and Bos-cawen). It is characterized by the reduction or absence of the barring of the under parts.

Lalage maculosa maculosa (Peale)

Colluricincla maculosa PEALE, 1848, U. S. Expl. Exped., Birds, p. 81.—Samoa and Fiji;

restricted to Upolu, Samoa, by Wetmore, Ibis, 1925, p. 847.

SUBSPECIFIC CHARACTERS (Adult Male).—Above glossy black, crown occasionally lightly streaked with white; the feathers of the back occasionally faintly tipped with white; rump gray, the feathers with a buffy white terminal and a blackish subterminal bar; upper tail-coverts more blackish; lores and a superciliary stripe white; a black streak from the base of the bill through the eye joining the nape; under parts white with a faint buffy wash, more pronounced on the chest, sides of throat and flanks; wings black, inner median wing-coverts white with a black shaft streak, greater, outer median, and some of the lesser wing-coverts edged or tipped with white or tawny white; tail black, central tail-feathers lightly tipped, the outer tail-feathers broadly tipped with white (12–16 mm.).¹

FIRST-YEAR MALE (Immature Plumage).—Crown and back blackish brown, the crown streaked with tawny brown or white, the feathers of the back sometimes lightly tipped with tawny; rump buffy gray; lores and a superciliary stripe white to buffy white; under parts white tinted with buff on the chest and flanks; the sides of the neck, breast, and flanks with irregular black vermiculation; wings dark brown, wing-coverts, secondaries, and primary coverts edged with white or tawny white; alula with a pale tip; tail dark brown with white tips; tail-feathers more pointed.

JUVENILE MALE (Nesting Plumage).—Above blackish, the feathers of the crown and back tipped with buffy white; rump grayish buff; below white; wing and tail as in the first-year male; basal half of the lower mandible yellowish.

ADULT FEMALE. —Variable, sometimes more like adult, sometimes more like first-year male. Crown and back rusty to glossy black, the crown sometimes streaked, sometimes tipped with buff; the feathers of the back tipped with whitish buff; rump feathers gray edged with buffy white; lores and a superciliary stripe whitish; below white with a faint buffy wash and some irregular black vermiculations on the sides of throat, breast, and flanks; wings and tail as in the adult male.

The first-year female is indistinguishable from the first-year male.

Tarsus 24–26 mm.; relative tail-length 70–74 per cent of wing-length.

Upolu	WING	TAIL
6 ♂ ad.	94–98 (96.5)	67–69 (67.8)
3 ♀ ad.	93–95 (94.5)	64–69 (67.2)
Savaii		
5 ♂ ad.	93.5–98 (96.2)	63.5–72 (67.9)
8 ♀ ad.	93–97.5 (95.5)	63–69 (66)

RANGE.—Upolu and Savaii Isls., Samoa. Wetmore, 1925, Ibis, p. 848, makes

Lalage sharpei Rothschild a synonym of *maculosa*, although in reality the two names refer to two different species of *Lalage* occurring in Samoa.

Lalage maculosa whitmeei Sharpe

Lalage whitmeei SHARPE, 1878, Mittheil. K. Zool. Mus. Dresden, I, p. 371.—Savage I.

SUBSPECIFIC CHARACTERS (Adult Male).—Similar to *maculosa*, but differing in the darker color of the rump which is gray with black tips; upper tail-coverts with white tips; crown black; a broad white superciliary not joining the white area on the sides of the neck.

IMMATURE FEMALE.—Back black; upper tail-coverts with buffy terminal bars and black sub-terminals; feathers of crown narrowly edged with brown; slightly barred on flanks and sides of breast; superciliary very broad.—White on tail about 22 mm.

Wing, ♂ 99, ♀ 98.

This description is based on two specimens in the Mus. Comp. Zool. at Cambridge.

RANGE.—Savage (Niue) I.

Lalage maculosa futunae, new subspecies

TYPE.—No. 251607, Amer. Mus. Nat. Hist.; ♂ ad.; Futuna I.; May 7, 1925, J. G. Correia.

SUBSPECIFIC CHARACTERS.—Similar to *maculosa*, but slightly smaller; rump darker, the feathers of the same color as the back but edged with white; post-ocular streak narrower; more white on upper wing-coverts; bill slightly longer (15, 15.5 as against 13–14.5). The amount of white on the outermost tail-feathers measures about the same (12, 13.5).

From the Tonga race, to which it seems less closely related, these birds differ by being smaller and by having no indication of a nuchal collar or white tips on the feathers of the back. The rump also is much darker and the amount of white on the tail more restricted. Tarsus 23, 25; relative tail-length 70, 73 per cent of wing-length.

	WING	TAIL
2 ♂ ad	91, 94	67, 66

RANGE.—Futuna I., Horne Isls.

Although there are only two specimens in the Whitney Collection they are so clearly distinct from specimens of the other races, that it seems justified to describe them as new.

Lalage maculosa keppeli, new subspecies

TYPE.—No. 250637, Amer. Mus. Nat. Hist.; ♂ ad.; Keppel I.; Aug. 25, 1925; J. G. Correia.

SUBSPECIFIC CHARACTERS.—Similar to *maculosa* but slightly larger; feathers of back from nape to rump broadly tipped with white, the

¹ Measured along the shaft of the inner web of outermost tail-feather.

nape largely white, forming a poorly defined nuchal collar; feathers of the upper back with broad white spots on the outer web; rump paler gray, white superciliary stripe wider and continuing down to join the whitish collar; tail more broadly tipped with white (16-21). Tarsus 24-27 mm.; relative tail-length 69-72 per cent of wing-length.

	WING	TAIL
Keppel		
5 ♂ ad.	98-100 (99)	67-70 (68.5)
5 ♀ ad.	96-99.5 (98)	65-71 (68)
Boscawen		
7 ♂ ad.	96-103.5 (100)	68-74.5 (71)
2 ♀ ad.	95, 98	63, 68

RANGE.—Keppel (Niuatobutabu) I. and Boscawen (Tafahi) I. Six of the males from Boscawen have very dirty, stained breast feathers.

Lalage maculosa vauana, new subspecies

TYPE.—No. 250614, Amer. Mus. Nat. Hist.; ♂ ad.; Vavau I., Tonga Is.; Aug. 11, 1925; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *maculosa* but slightly larger; crown with white streaklets; white on the sides of the neck extended dorsally to form the beginning of a nuchal collar, occasional feathers on the back faintly tipped with white; rump more gray; more white on tail-feathers (15-18). From *whitmei* this bird differs in the color of the rump as it does also from *futunae*, a somewhat smaller race. From *keppeli* it differs in having an incomplete collar, slightly less white on the tail and by not having the broad white tips to the feathers on the back.

The adult female resembles the female of *maculosa* but with more pronounced streaklets on the crown; more white on the sides of the neck; rump purer gray, less buffy. Tarsus 25.5-27.5; relative tail-length 67-72 per cent of wing-length.

	WING	TAIL
Okaka		
1 ♀ ad.	92	..
Vavau		
9 ♂ ad.	94.5-101 (97.2)	64-70.5 (67.7)
1 ♀ ad.	91	66
Kapa		
1 ♂ ad.	93.5	65
Euakapa		
1 ♂ ad.	95.5	63
Late		
1 ♀ ad.	96	62

RANGE.—Okaka, Vavau, Kapa, Euakapa, and Late (Vavau group), Tonga Is.

Lalage maculosa tabuensis, new subspecies

TYPE.—No. 250568, Amer. Mus. Nat. Hist.; ♂ ad.; Tongatabu I., Tonga Is.; July 6, 1925; J. G. Correia.

SUBSPECIFIC CHARACTERS.—Differs from *vauana* in the more pronounced nuchal collar and the greater amount of white edging on the feathers of the back. Many of the feathers of the uppermost back have a narrow hidden white longitudinal streak alongside the shaft on the outer web. From *keppeli* it differs by having the edging and particularly the hidden longitudinal streaks much less pronounced; less white on tail (15-18.5).

The adult female of *tabuensis* has much more brownish upper parts as well as a more pronounced white collar and edging to the feathers of the back than *vauana*. From *keppeli* it differs in the same way as the male, also by having the crown and back much browner, less blackish. Tarsus 25-27.5; relative tail-length 68-71 per cent of wing-length.

		WING	TAIL
Tongatabu	1 ♂ ad.	98	68.5
Eua	2 ♀ ad.	96, 101.5	64, 68
Kelelesia	3 ♂ ad.	98.5-99	67.5-69
	1 ♀ ad.	95	67.5
Namuka	1 ♂ ad.	96	67.5
Mango	1 ♂ ad.	99	70
	1 ♀ ad.	95	66
Tofua	2 ♂ ad.	94.5, 99	64, 67
	2 ♀ ad.	92, 94	60, 65
Kao	1 ♀ ad.	93	60
Fotuhaa	1 ♂ ad.	96.5	64
Tongua	1 ♂ ad.	96	66
Uanukuhahaki	3 ♂ ad.	95-97.5	65-67
	1 ♀ ad.	96.5	64
Oua	2 ♂ ad.	97.5, 98	65, 68
Uoleva	2 ♂ ad.	98, 99	67, 70
	1 ♀ ad.	95.5	63.5
Foa	2 ♂ ad.	94, 98	67, 70
	1 ♀ ad.	91	63

RANGE.—Tonga Is., except Vavau group; Tongatabu Eua and (subspecies) Kelelesia, Tonumeia, Telekitonga, Mango, Namuka, Tofua, Kao, Fotuhaa, Haafeva, Tongua, Uanukuhahaki, Oua, Uoleva, Lefuka, and Foa.

Although we have included the population of the central Tonga Is., the Haapai group, within the range of *tabuensis*, these birds differ slightly by having somewhat more white on the tips of the feathers of the back. It does not seem to us that the difference is pronounced enough to justify separation.

Mathews (Syst. Av. Austr., II, p. 548), in a footnote, has pointed out that *Turdus pacificus* Gmelin is not applicable to any *Lalage*. It is apparent from Gmelin's description (Syst. Nat., I, pt. 2, 1789, p. 813) that his bird must have been much darker below and lacking any white on the

lores, wings or rump. It is most likely that Gmelin's *pacificus* refers in reality to *Clytorhynchus heinei* (Finsch and Hartlaub), but as the type is no longer in existence, as inquiries at the British and Vienna museums have revealed, the exact identity of *pacificus* can never be proved, and it seems best to discard this name as unidentifiable.

***Lalage maculosa nesophila*, new subspecies**

TYPE.—No. 251463, Amer. Mus. Nat. Hist.; ♂ ad.; Ongea Levu I., Fiji Isl.; July 30, 1924; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Most similar to *keppeli*, but differs by having much less prominent white tips to the feathers of the back and a less well-defined nuchal collar; white on tail somewhat reduced (12–18.5) as against (16–21). Under parts slightly more washed with buff. The female differs from that of *keppeli* by having a decidedly more brownish cast to the feathers of the upper parts.

Similar to *tabuensis* but more prominent streaklets on crown and averaging more white on the tips of the feathers of the back; white streaks on the feathers of the upper back much more pronounced; less white on tail; buffy wash on lower parts more distinct. Tarsus 25–26.5; relative tail-length 65–73 per cent of wing-length.

RANGE.—Lau Archipelago (Ono Ilau, Turtle, Ongea Levu, Fulanga, Yangasa Cluster, Marambo, Kambara, Wangava, Tavunasithi, Namuka Ilau, Mothe, Olorua, Oneata, Aiwa, Lakemba, Matuku, Vatu Vara, and Yathata), Fijii Isl.

Birds from the three islands (Matuku, Vatu Vara, and Yathata) closest to the main Fijian islands show a slight tendency toward *woodi* in their smaller size, somewhat more rusty, less glossy color of the back, and reduced collar.

The barred *maculosa* forms

***Lalage maculosa woodi* Wetmore**

Lalage woodi WETMORE, 1925, Ibis, p. 845, Pl. XXVI.—Taveuni I., Fiji.

SUBSPECIFIC CHARACTERS.—Similar to *maculosa* but smaller; crown (in some specimens) with white streaklets; feathers of the upper back with a partly concealed white spot, broader on the outer web; feathers of back and scapulars black, lightly tipped with buffy white; white on wing-coverts somewhat reduced; white tips on outermost tail-feathers somewhat smaller (10–14). Under parts white with a buffy tint; extensive black V-shaped barring on the feathers of the cheeks, sides of the neck, flanks, and in some specimens across the breast and upper abdomen. The feathers of the posterior end of

		WING	TAIL
Ono Ilau	1 ♂ ad.	96.5	69
	2 ♀ ad.	97, 97.5	65, 70
Turtle (Vatou)	3 ♂ ad.	98–99.5	67–70
	3 ♀ ad.	96–99	67–69
Ongea Levu	5 ♂ ad.	96.5–99 (97.6)	65–69 (66.8)
	2 ♀ ad.	95, 95	63, 64
Fulanga	6 ♂ ad.	96–99.5 (97.5)	64–69 (65.5)
	2 ♀ ad.	92, 94.5	64, 63.5
Yangasa Cluster	1 ♀ ad.	92.5	64
Marambo	1 ♂ ad.	97	69
	1 ♀ ad.	96.5	65
Kambara	1 ♀ ad.	93	65
Wangava	1 ♀ ad.	95	66
Tavunasithi	4 ♂ ad.	95–100 (97.2)	63–67 (64.4)
	1 ♀ ad.	94	64
Namuka Ilau	4 ♂ ad.	97–99 (98.2)	68–72 (69.5)
	4 ♀ ad.	94–99 (96.8)	66, 68
Mothe	4 ♂ ad.	94–98 (96.1)	68–71 (69.5)
Olorua	1 ♂ ad.	98.5	69
	2 ♀ ad.	95.5, 97.5	66
Oneata	3 ♂ ad.	95–100 (97.9)	66–70 (67.6)
	1 ♀ ad.	94.5	65
Matuku	3 ♂ ad.	94–97 (95.6)	64.5–66 (65.3)
	3 ♀ ad.	91.5–95 (93.3)	65–68 (66.2)
Vatu Vara	4 ♂ ad.	93–98 (94.9)	60–67 (63.7)
	2 ♀ ad.	92, 94	62, 64
Yathata	2 ♂ ad.	94, 95	66, 64.5

the superciliary stripe are barred and, in some specimens, this pattern is carried down to join the barred neck feathers.

From *nesophila* this bird differs by its smaller size, no indication of a collar, and by having less pronounced tips on the feathers of the back; rump darker and more buffy; less white on tail; extensive barring on under parts.

The female differs by the same characters as the male. Tarsus 23-25; relative tail-length 68-72 per cent of wing-length.

	WING	TAIL
Ngamea		
5 ♂ ad.	93-95.5 (94.1)	63-65 (63.8)
Taveuni		
3 ♂ ad.	90.5-94 (92.9)	60-64 (61.8)
2 ♀ ad.	90, 95	58, 61
Kio (Kioa)		
5 ♂ ad.	85-91 (87.8)	59-65 (61.8)
1 ♀ ad.	86.5	61
Vanua Levu		
4 ♂ ad.	85.5-92.5 (88.6)	62, 63.5
6 ♀ ad.	85-87.5 (86)	58-61 (59.6)

RANGE.—Eastern group of the main Fiji Isls. (Ngamea, Taveuni, Kioa, and Vanua Levu).

The populations from the northeastern Fijian islands represent a continuous cline from Ngamea to Vanua Levu (and continued by the Ovalau race) involving the following characters: decrease of size, increase of brown on the back, and increase of buff color and barring on the under parts. In order to show the trend of variation more clearly a description of the different populations follows:

NGAMEA.—Largest; very dark above with gray rump and reduced tips on back feathers; limited amount of barring on sides of neck and breast; faint buffy wash on breast and flanks. Birds from Ngamea as might be expected are closest in general appearance to *nesophila*.

TAVEUNI.—Typical *woodi*.

KIOA.—Two of five adult males have a good deal of brown on the back, particularly in the scapular area (due to wear). All have slightly more buff on the rump and three have rather heavy barring below.

VANUA LEVU.—There is some evidence for believing that there are two populations on this island. December birds (from Thakandrove Peninsula) are close to typical *woodi*, while two February birds (Western Vanua Levu) have more brown on the back, buffy gray rumps and a heavy buffy wash on the sides of the neck; under parts rather heavily barred.

The populations on the following islands, although still belonging to the same cline, are too distinct to be included with *woodi*.

There is a graded series of populations, as stated above, with the Ngamea birds forming the eastern extreme and the Ovalau birds the western one. Where the line is to be drawn, is largely a matter of opinion, but we believe that it is best to include Vanua Levu with the Taveuni race, and the small islands off Vanua Levu with the Ovalau race.

Lalage maculosa mixta, new subspecies

TYPE.—No. 251543, Amer. Mus. Nat. Hist.; ♂ ad.; Ovalau I.; Oct. 22, 1924; Mrs. Correia.

SUBSPECIFIC CHARACTERS.—Similar to *woodi* but slightly smaller; back rusty brownish black; rump darker, more buffy; buffy wash more pronounced on sides of neck and under parts; barring somewhat more extensive and carried right across the chest; same amount of white on tail (10-14.5).

The female differs from that of *woodi* by being somewhat more brownish on the upper parts; tips on the feathers of the back somewhat more buffy producing less of a contrasted or barred effect. Other characters differ as in the male. Tarsus 23-24.5; relative tail-length 69-72 per cent of wing-length.

	WING	TAIL
Mathuata		
2 ♂ ad.	81.5, 88	61, 64
4 ♀ ad.	82-86.5	60, 61
Yendua (Yandua)		
1 ♀ ad.	88	61
Ovalau		
4 ♂ ad.	86.5-89 (87.8)	62-65 (63.3)
1 ♀ ad.	87	59
Matathoni		
1 ♂ ad.	87	60
Yasawa		
1 ♂ ad.	89	61.5

RANGE.—Ovalau and (subsp.?) Mathuata, Yandua, Naviti, Matathoni Levu, and Yasawa Isls., central and northern Fijian group.

In the Whitney Collection, there are specimens from several of the smaller islands which apparently belong to this race, but show a tendency toward *woodi* in some characters:

MATHUATA.—One adult male shows somewhat more black on the back and rather less barring on the lower parts than Ovalau birds.

NAVITI.—An immature male is very blackish above but otherwise agrees well.

MATATHONI.—An adult male is rather less buffy below and with more reduced barring than typical Ovalau birds.

YASAWA.—An adult male is slightly more blackish on the upper parts.

Lalage maculosa pumila Neumann

Lalage nigra pumila NEUMANN, 1927, Ornith. Monatsb., XXXV, p. 19.—Viti Levu, Fiji Isls.

SUBSPECIFIC CHARACTERS.—Similar to *woodi* but slightly smaller; upper parts suffused with rusty brown, the back especially being very dark brown; rump tawny gray; under parts slightly more buffy and much more heavily barred.

From *mixta* this race differs by being much browner, less blackish, on the back, and by having the rump more suffused with tawny; white on tail somewhat more reduced (9–13). Tarsus 22.5–24.5; relative tail-length 67–72 per cent of wing-length.

	WING	TAIL
Viti Levu		
5 ♂ ad.	84–90 (87.3)	58–65 (60.7)
7 ♀ ad.	83–92 (86.4)	55–62 (59.3)

RANGE.—Viti Levu I., Fiji Isls.

Lalage maculosa soror, new subspecies

TYPE.—No. 251552; Amer. Mus. Nat. Hist.; ♂ ad.; Kandavu I.; Nov. 10, 1924; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *pumila*, but with much less barring on the feathers of the under parts and more white on the tips of the outermost tail-feathers (13–16.5 as against 9–13). Tarsus 25–25.5; relative tail-length 70–75 per cent of wing-length.

	WING	TAIL
Kandavu		
5 ♂ ad.	87–92 (88.2)	60–65 (61.9)
3 ♀ ad.	87–91 (89.1)	58–62 (59.8)

RANGE.—Kandavu I., Fiji Isls.

This race seems to be notable by having a well-contrasted black cap and nape and dark brown back. Although a similar condition exists in *pumila*, the line of demarcation is not as clearly defined. The five adult males in the Whitney Collection are in slightly worn plumage, but not worn enough to warrant the supposition that the black-capped plumage is a composite of a freshly molted crown and a worn back.

Lalage maculosa rotumae Neumann

Lalage nigra rotumae NEUMANN, 1927, Ornith. Monatsb., XXXV, p. 19.—Rotuma I.

SUBSPECIFIC CHARACTERS.—Similar to *maculosa* but smaller; feathers of the upper back with hidden buffy white spots; rump black with buffy tips to the feathers; under parts with a good deal of barring on the sides of the neck, breast, and flanks; a very pronounced bright tawny wash on throat, breast, and sides of neck; with a more tawny less white edging to the feathers; white on tail about the same (11–15).

From *woodi*, to which it seems to be most

closely related, *rotumae* differs by being larger and by having a much more tawny coloration on the tips of the feathers of back and rump, on wing-coverts, and on the under parts. The female differs as the male. Tarsus 23–24.5; relative tail-length 71–74 per cent of wing-length.

	WING	TAIL
Rotuma		
12 ♂ ad.	91–97 (94.2)	63–70 (68.6)
9 ♀ ad.	90–99.5 (94.7)	62–68 (65.3)

RANGE.—Rotumah I. (north of the Fiji group).

This very distinct race comes closest of all the outlying island populations to *woodi*, while at the same time showing a trend toward *maculosa* in the larger size and very dark, lightly barred upper parts.

The maculosa forms of Southern Melanesia

West of the Fijian islands, this species is confined to the three larger islands of the Santa Cruz group (Vanikoro, Utupua, and Santa Cruz), and to a few of the larger islands of the New Hebrides (Espiritu Santo, Malo, Pauuma, Epi, and Efate). No specimens were secured by the Whitney expedition from the other groups of islands in the area. The population from these islands shows an interesting combination of characters. The males have the general coloration of blue-black upper parts and very indistinct, nearly absent, barring below of the *maculosa* group, while the females have the dull brown coloration on the upper parts and a tendency toward barring below, as found in the females of the *woodi* group.

Lalage maculosa vanikorensis, new subspecies

TYPE.—No. 214203, Amer. Mus. Nat. Hist.; ♂ ad.; Vanikoro I., Santa Cruz group; Sept. 24, 1926; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Adult male. Similar to *vauana* but smaller throughout; streaklets on crown more pronounced; no trace of a collar; gray on the rump much reduced; shaft-streaks on white lesser and median wing-coverts less pronounced, white on tail about the same (14–18); under parts with faint fragmentary barring on the sides of the neck and flanks.

The adult female resembles the female of *pumila* rather closely but differs by being smaller, paler brown on the crown with tawny streaklets and with a suffusion of gray in the rump; barring on the under parts very much reduced. Tarsus

22-23; relative tail-length 73, 75 per cent of wing-length.

	WING	TAIL
Vanikoro		
4 ♂ ad.	83-87 (85.3)	63-67 (64.5)
5 ♀ ad.	83-86 (84.2)	59-64 (62.1)

RANGE.—Vanikoro I., Santa Cruz group.

Lalage maculosa melanopygia, new subspecies

TYPE.—No. 214207, Amer. Mus. Nat. Hist.; ♂ ad.; Utupua I., Santa Cruz group; Sept. 28, 1926; J. G. Correia.

SUBSPECIFIC CHARACTERS.—Similar to *vanikorensis* but upper parts more uniform black; streaklets and barring on crown and back nearly absent; rump black with faint white tips; tail with equal amount of white (12.5-18).

The female differs from the female of *vanikorensis* as the male, the general tone of the upper parts being somewhat darker; rump rather blackish. Tarsus 22, 22.5; relative tail-length 74, 76 per cent of wing-length.

	WING	TAIL
Utupua		
2 ♂ ad.	85, 87	65, 65
1 ♀ ad.	84	65

RANGE.—Utupua I., Santa Cruz group.

Two immature birds are not quite as dark as the adult female, but differ from the female of *vanikorensis* by being slightly darker on the upper parts, particularly the rump.

Lalage maculosa subspecies

	WING	TAIL
Santa Cruz		
2 ♂ ad.	89.5, 90.5	65, 66
1 ♂ imm.	89.5	67

RANGE.—Santa Cruz (Ndeni) I., Santa Cruz group.

These three specimens although close to *melanopygia* are larger with much paler rumps. It seems best to postpone the naming of this apparently undescribed form until more material is available.

Lalage maculosa modesta, new subspecies

TYPE.—No. 212836, Amer. Mus. Nat. Hist.; ♂ ad.; Pauuma I., New Hebrides Isls.; Aug. 12, 1926; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *vanikorensis* but larger; rump more gray; under parts with a greater tendency to barring on the sides of the neck and breast; a distinct buffy

wash, more pronounced on the breast; white on tail about the same (12-17).

The female differs from the female of *vanikorensis* by being larger; the upper parts more tawny and somewhat paler, particularly on the rump. From *pumila* this bird differs by having the upper parts, particularly the rump, paler, and by lacking the barring on the under parts. Tarsus 24, 24; relative tail-length 75-79 per cent of wing-length.

	WING	TAIL
Pauuma		
1 ♂ ad.	90	68
4 ♀ ad.	87-90.5 (88.5)	66-70 (67.8)
Epi		
2 ♂ ad.	89, 91	65, 72
1 ♀ ad.	95	72
Espiritu Santo		
1 ♂ ad.	88	63
Malo		
1 ♂ ad.	86	68

RANGE.—Northern and Central New Hebrides (Espiritu Santo, Malo, Pauuma, and Epi).

Two specimens from Espiritu Santo and Malo are less barred on the under parts and slightly smaller than Pauuma and Epi birds, but a larger series is needed to confirm this difference.

Lalage maculosa ultima, new subspecies

TYPE.—No. 212834, Amer. Mus. Nat. Hist.; ♂ ad.; Efate I., New Hebrides Isls.; July 21, 1926; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *modesta* but larger; streaklets on crown and barring on back more pronounced; gray area on rump more extensive and more uniform; under parts pure white with virtually no trace of a buffy wash; white on sides of neck more extended dorsally.

The female differs from the female of *modesta* by averaging somewhat larger and by being paler above with a very pronounced pale grayish rump; white on tail about the same (14.5-17.5). Tarsus 23, 23.5; relative tail-length 73, 74 per cent of wing-length.

	WING	TAIL
Efate		
2 ♂ ad.	95, 96	70, 70.5
3 ♀ ad.	91-94.5 (92.6)	70-74 (71.7)

RANGE.—Efate I., Central New Hebrides.

The male of the Efate race is remarkably close in general coloration and size to the male of *tabuensis*, the only appreciable difference being the very uniform gray appearance of the rump. The female, on

the other hand, is quite distinctive and differs appreciably from all other races of *maculosa*.

Lalage sharpei

This species is apparently most closely related to *Lalage maculosa pumila* from which it differs by being much smaller, by having no sexual dimorphism, the plumage of both sexes being of a characteristically juvenile type, and by having a white, not brown iris. Both sexes have a yellow bill and lack the prominent white wing patch. For this reason Mathews separated *sharpei* from *Lalage* and placed it in the genus *Oscarornis* (1928, Novit. Zool., XXXIV, p. 372). Although these plumage differences are very great, it is apparent that the pattern of the plumage is arranged precisely in the same way as in the *woodi* group, that in fact *sharpei* is an offshoot of the original *Lalage maculosa* population in the Fiji islands which has evolved in a retrogressive manner, and changed to such a degree that it did not produce hybrids with the succeeding wave of immigrants to Samoa, the *maculosa* group.

Lalage sharpei sharpei Rothschild

Lalage sharpei ROTHSCHILD, 1900, Bull. Brit. Orn. Club, X, p. XI, Upolu Island, Samoa Group.

SUBSPECIFIC CHARACTERS.—Upper parts hair brown, shafts of the feathers slightly darker; rump darker, nearly olive-brown; wings blackish brown with pale edges; tail colored as back with very faint buff tips; outermost tail-feathers with poorly defined whitish tips (13–16.5); under parts white with a buffy wash and irregular dark brown barring on sides of neck, across breast, and flanks. "Iris white, bill yellow, feet brownish brown." Tarsus 22.5–23.5; relative tail-length 64–68 per cent of wing-length.

	WING	TAIL
Upolu		
5 ♂ ad.	79–86 (82.4)	55.5, 56
1 ♀ ad.	81	54

RANGE.—Upolu I., Samoan group.

It is interesting to note that this species has a much more rounded wing than *maculosa* or *leucopyga*, the sixth primary being nearly as long if not as long as the second.

Lalage sharpei tenebrosa, new subspecies

TYPE.—No. 206142, Amer. Mus. Nat. Hist.; ♂ ad.; Savaii I., Samoa Group; May 23, 1924; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *sharpei* but much darker; upper parts dark olive-brown (Bistre of Ridgway); rump sepia; wings very dark blackish brown; tail as the back; ear-coverts and sides of hind-neck much darker, almost blackish in some individuals; under parts white with a buffy or tawny wash on sides of neck, on the breast and, extensively, on the flanks; barring on the under parts much heavier; extent of whitish on tail somewhat greater (14–19). Tarsus 22, 23; relative tail-length 68–72 per cent of wing-length.

	WING	TAIL
Savaii		
4 ♂ ad.	78–83 (80.7)	55–60 (57.1)
5 ♀ ad.	78–85 (80.6)	54–57.5 (55.8)

RANGE.—Savaii I., Samoa group.

CHARACTER GEOGRAPHY IN THE AUREA GROUP

Geneticists are becoming increasingly interested in the geographical distribution of certain genes within the geographical range of wild species and about the possible history of the point of origin of the mutation and its subsequent spread. Nothing is known about the genetics of *Lalage*, but there is, of course, no doubt that the various characters, used by the taxonomist, have a genetic basis. A discussion of the geographical distribution of these characters is, therefore, of general interest.

Most of the variable characters in the *Lalage aurea* group are such as vary in a similar manner in many other genera of the Campephagidae. Such characters are:

- 1.—General size.
- 2.—Proportions (as relative length of tail and bill).
- 3.—Degree of barring on upper and under parts.
- 4.—Presence and size of white marks in otherwise black regions of the body (superciliary, scapulars, upper wing-coverts, tips of tail-feathers).
- 5.—Color of rump.
- 6.—Presence and degree of buff or rufous color of under parts.
- 7.—Color (brown, gray, or black) of upper parts (in both sexes).
- 8.—Degree of sexual dimorphism, etc.

In regard to most of the characters just listed there are different potentialities within the genus. Often these latent potentialities are realized in different parts of the range, as is neatly demonstrated on the map (Fig. 1). Most of the mentioned

characters vary rather independently and it would, therefore, be a mistake to base a classification on only one of them. The barring has been lost independently at least five times in the *Lalage aurea* group (*atrovirens*, *yorki*, *ottomeyeri*, *conjuncta*, *maculosa*), and it would, therefore, be quite

an artificial arrangement to group the unbarred birds together as opposed to the barred ones. The same could be said of any other character. A more detailed analysis of some of the characters permits the following conclusions (see also tabulation):

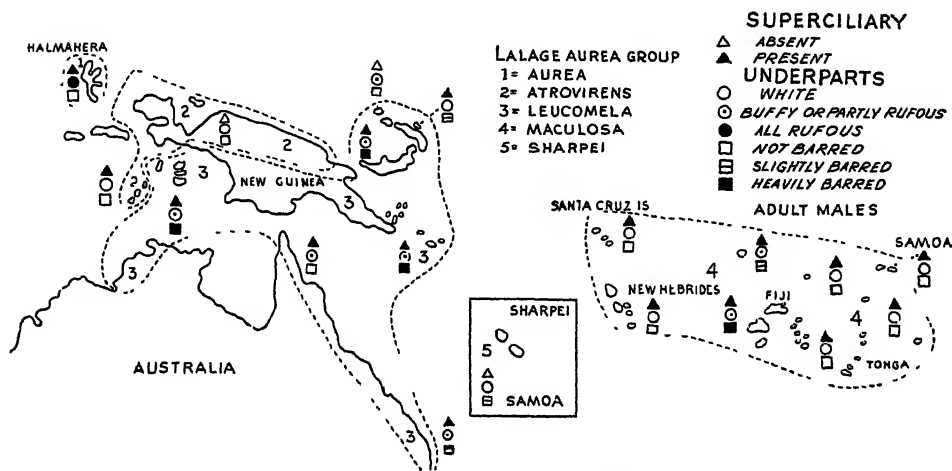


Fig. 1. Geographical variation of three (of a total of about fifteen) taxonomically important characters of the *Lalage aurea* group. A double invasion, first by *sharppei*, later by *maculosa*, has taken place on Samoa.

INDEPENDENT VARIATION OF FOUR CHARACTERS IN *Lalage*

<i>Lalage</i> (♂)	Barring of under parts	Buff or rufous of under parts	Superciliary	Rump
<i>aurea</i> —Halmahera	---	+++	+	Black
<i>moesta</i> —Tenimber	---	---	+	Black, white tips
<i>atrovirens</i> —North New Guinea	---	---	---	White tips
<i>polygrammica</i> —E. and S. New Guinea	++	+	+	Gray, white tips
<i>pallascens</i> —E. Louisiades	+	+	+	Grayish black, white tips
<i>conjuncta</i> —St. Matthias	---	++	---	Mostly white
<i>leucomela</i> —E. Australia	+	+	+	Gray
<i>vanikorensis</i> —Santa Cruz	trace	---	+	Blackish gray, pale tips
<i>ultima</i> —New Hebrides	---	---	+	Gray
<i>pumila</i> —Viti Levu, Fiji	++	+	+	Brown
<i>woodi</i> —Taveuni, Fiji	+	---	+	Dark gray
<i>keppeli</i> —Keppel	---	---	+	Gray, white tips
<i>maculosa</i> —Samoa	---	---	+	Black, white tips
<i>sharppei</i> —Samoa	++	+	---	Brown

(a) BARRING.—Completely absent in the species *aurea* (♂ and ♀) and *atrovirens* (♂ only). Pronounced in most forms of the species *leucomela*, but much reduced in *yorki*, *pallascens* and *albidior* (♂ only) and absent in *ottomeyeri* and *conjuncta*. In *maculosa* it is noticeable only in the *woodi* group, but is more or less obsolete in the *maculosa* and *vanikorensis* groups. It is rather strong in *sharpei*.

(b) SUPERCILIARY.—Is present in all forms except *atrovirens* (of north New Guinea), *leucop-tera* (Biak), *conjuncta* (St. Matthias), and *sharpei* (Samoa).

(c) PHAEO-MELANIN ON UNDER PARTS.—Strongest in *aurea*, and present in all forms of *leucomela*, except *ottomeyeri*, though often restricted to the under tail-coverts or to a slight wash of the under parts. Barely indicated in some forms of *maculosa*, absent in most of them and in all the forms of *atrovirens*.

(d) WHITE ON TAIL.—Least in *aurea*, *conjuncta*, and *atrovirens* (4–7 mm.) and most in the *maculosa* forms, particularly *keppeli* (20 mm.). *L. leucomela* is intermediate (10–15 mm.).

(e) SIZE.—The smallest species is *sharpei* (81 mm.), the largest form is, naturally, the sub-tropical *leucomela* (E. Australia) (104 mm.).

(f) THE RELATIVE TAIL-LENGTH.—The tail is shortest in the smallest species: *sharpei* (68%), and longest in the largest form: *leucomela* (86%). Allometric growth is, therefore, clearly involved, although no strict correlation exists. In general the species *maculosa* has a short tail (69–73%), the *aurea-atrovirens* group a medium sized tail (76–82%), and the species *leucomela* a long tail (80–86%), although there are forms of about comparable size in each group.

(g) DEGREE OF SEXUAL DIMORPHISM.—There is considerable geographical variation within each one of the three groups: *aurea-atrovirens*, *leucomela*, and *maculosa-sharpei*. The primitive type is probably represented by *leucomela* with pronounced sexual dimorphism and with the female wearing a "juvenile" or truly feminine plumage, which is strongly barred underneath and grayish or brownish above. In *atrovirens* the male acquires a strongly masculine plumage (without barring below), but the female is still barred; in *aurea* the female loses the barring and becomes very similar to the male, except for the gray upper parts. The same process, to a lesser extent, occurs within *leucomela*, but the barring is always present in the females, even where it is reduced or absent in the males (see under a). The female of *conjuncta* is still unknown, but can be expected to be barred. Particularly interesting conditions are found in *maculosa*. The Fijian group (*pumila*, etc.) represents the primitive condition with slight sexual dimorphism, but male plumage of a rather feminine type (barred below, considerable brown above). Two lines of development branched off from this basic stock, a retrogressive branch, turning into *sharpei*, which lost its sexual dimorphism in connection with the acquisition by male and female of a similar "juvenile" plumage, and a progressive

branch, culminating in *maculosa*, *keppeli*, etc., with very masculine males (glossy black above, no barring below) and only slight sexual dimorphism, because the females have acquired a masculine plumage (rather blackish above and nearly without all the barring below). *L. m. vanikorensis* (etc.) represents a somewhat intermediate condition, the males have already reached a highly masculine plumage, but the females still retain a rather feminine dress, with the result that these forms show a strong sexual dimorphism.

The unique interest of *L. sharpei* (Samoa) lies in the fact that it can be demonstrated that its primitive plumage is a secondary development. The species fits the requirements of the palaeontologist's rule that "primitive" species should be found on the borders of the range of the genus, but in this case the "primitive" species has not been "forced out" by its more progressive congeners, rather it has "deteriorated" in its isolation.

Other forms of the *aurea*-group are culmination points of specialization processes, for example, *aurea* with its complete loss of barring in male and female, and the deep rufous tawny wash of the under parts, otherwise unique in the genus, although approached by *conjuncta*. Another such specialized peak is *L. m. keppeli* with its strong albinisation factor. This form not only has the broadest white tail-tips and the broadest white superciliary, but it has white patterns also in a number of body regions which are free of white in the other forms and species of *Lalage*: There is a white collar across the hind-neck, the feathers of the back have broad white margins, the scapulars have broad white concealed spots, the white superciliaries merge into a white forehead and connect with the white on the sides of the neck, etc. To a lesser degree a similar albinisation is apparent in some of the neighboring forms (*nesophila*, *tabuensis*, etc.). It is important to point out that it does not occur anywhere else in the range of the genus *Lalage*.

In conclusion we might mention some of the potentialities of Campephagidae which are not realized in the genus *Lalage*. For this we only have to point to the closely related genus *Campochaera* (type, *sloetii*; range, New Guinea). This genus differs from *Lalage*: (a) by the presence of yellow

lipochrome above and below, (b) a black throat pattern, and (c) by elongated and pointed tail-feathers.

leucopyga group

Lalage leucopyga

This group (with the single species *leucopyga*) apparently branched off from its ancestral stock at a very early date, and it is, therefore, impossible to trace its exact relationship. In some characters, such as the white pattern on the wing-coverts, it seems to approach *L. sueurii tricolor*. In other characters (coloration of rump, shape of bill, sexual dimorphism), it seems to be closer to the *aurea*-group (*atrovirens*, etc.). The fact that *L. sueurii tricolor* seems to be a rather recent immigrant in Australia and that most of the endemic clement of southern Melanesia seem to be of Papuan origin, makes it very likely that *leucopyga* is more closely related to the *aurea* assemblage than to *L. s. tricolor*.

In comparison with the other species of the genus the *leucopyga* group has softer, more downy plumage, lacks barring of the under parts (even in the female dress), has usually a pronounced buffy wash on the under parts and, in general, has more white on the greater upper wing-coverts. In its long isolation on the islands of southern Melanesia, it developed some rather unusual structural peculiarities. The tail is rather long in most forms of this species, up to 97 per cent of the wing-length. The basal part of the shafts of the rump feathers is rather soft, not stiffened as in most *Lalage*. These characteristics were considered a sufficient excuse by Gould to erect a new genus *Symmorphus* (= *Diaphoropterus* Oberh.). In our opinion there is no justification for keeping *leucopyga* in a separate genus. Its coloration indicates its close relationship with the other species of *Lalage*, and both relative tail-length and lack of stiffness in the rump-feathers are nothing more than specific characters.

Lalage leucopyga leucopyga (Gould)

Symmorphus leucopygus GOULD, 1838, Synops. Birds Austr., pt. IV, App., p. 3.—"New South Wales," in error for Norfolk I.

ADULT MALE (Normal Plumage).—Crown and

back glossy black, rump white, strongly tinged with buff; under parts white, strongly washed with buff, particularly on breast and flanks; an indistinct white spot on lores; wing black, secondaries and inner primaries narrowly bordered with white; almost all of the lesser, all median, and the inner greater upper wing-coverts white; upper tail-coverts gray; two central pairs of tail-feathers all black, others broadly tipped with white; extent of white on outermost tail-feather is 26–29 mm.¹

ADULT MALE (Retarded Plumage).—Similar to immature plumage, but alula all dark brown, and wing and tail-feathers broad as in adult. Occasionally a few glossy black feathers are interspersed among the feathers of the crown and back, particularly the crown. Of a series of 28 adult males from Norfolk I., 10 are in the retarded plumage.

IMMATURE MALE (First Year).—Crown and back dark blackish brown; rump white, heavily suffused with buff; under parts white, strongly washed with buff (somewhat more buffy than the adult); lores white; wing dark brown, secondaries and inner primaries narrowly bordered with pale tawny to white, alula tipped with white, lesser and median wing-coverts strongly washed with tawny; inner greater upper wing-coverts buffy white. Two central pairs of tail-feathers brown narrowly tipped with white, others brown tipped as in the adult. The wing and tail-feathers are rather narrower than the adult, and the basal half of the brown mandible is usually pale yellowish.

NESTLING (Juvenile Plumage).—Above dark brown, the feathers of the crown and back widely banded with buffish white; rump white, tinted with buff; below white, the chest tinted with buff, some of the feathers of the throat and chest faintly streaked with brown; wings and tail as in the immature.

ADULT FEMALE.—As the immature, except for the adult character of the wing and tail-feathers and the solid color of the alula. Indistinguishable from the adult male in retarded plumage.

Tarsus 24.5 mm.; length of tail 92–95 per cent of wing-length.

♂, ♀ ad.—Wing, 87–93; tail, 83–88

RANGE.—Norfolk I.

Lalage leucopyga montrosieri Verreaux et des Murs

Lalage montrosieri VERREAUX ET DES MURS, 1860, Rev. et Mag. de Zool., p. 431.—New Caledonia (fig. Sarasin, Pl. II, fig. 9).

Muscicapa naevia GÜNTHER, 1789, Syst. Nat., I, pt. II, p. 994, preoccupied by *Muscicapa naevia* Boddaert, 1783, p. 34.

SUBSPECIFIC CHARACTERS.—Similar to *leucopyga*, but smaller; rump almost pure grayish white, only faintly tinted with buff; below white, lightly washed with buff; amount of

¹ Measured on inner web along shaft.

white on lores variable, but tends to be much more reduced than in the typical race; less white on upper wing-coverts; two central pairs of tail-feathers black, narrowly edged and tipped with white; the outer tail-feathers with broad white tips; the outermost tail-feathers about half white (14–25 mm.).

The female and retarded male plumages are like those of *leucopyga*, but less suffused with buff on the rump and below.

Tarsus 22–24; relative tail-length 94–95 per cent of wing-length.

	WING	TAIL
8 ♂ ad.	85–90.5 (88)	81–84 (83)
7 ♀ ad.	83–87.5 (86)	79–83 (81)

RANGE.—New Caledonia.

Only one specimen (No. 564513, in the American Museum's collection collected on Cut Panie, Aug. 25, 1914) appears to be a male in retarded plumage. The tail though molting is adult in character as are the wings. The retarded plumage seems to be much rarer in this form than in the Norfolk Island race.

Lalage leucopyga simillima (Sarasin)

Diaphoropterus naevius simillimus SARASIN, 1913, "Vög. Neu Caled. Loyalty Ins.," p. 28, Pl. II, fig. 10.—Loyalty Isls.

SUBSPECIFIC CHARACTERS.—Similar to *montrosieri* but slightly smaller, with a shorter tail and with less white on tail (11.5–19 mm.). The white area on the wing-coverts is more restricted. Below, the buffy wash seems to be confined to the breast in the male. The rump is almost pure white or grayish white.

The female of *simillima* differs from the female of *montrosieri* in the much darker, almost blackish brown, color of the upper parts, which is continuous throughout and does not become paler at the forehead as in the New Caledonia and Norfolk Island birds.

Tarsus 21–22; relative tail-length 84–91 per cent of wing-length.

	WING	TAIL
Maré		
1 ♂ ad.	82	72.5
1 ♀ ad.	87	78.5
Lifu		
5 ♂ ad.	84–87 (86)	70–78 (75)
4 ♀ ad.	83–88 (85)	71–79 (75)
Uvea		
6 ♂ ad.	82–88 (85)	75–80 (77)
2 ♀ ad.	82, 83	74, 77

RANGE.—Loyalty Islands and (subsp.) southern New Hebrides (Erromango, Tanna, Aneiteum).¹

In the American Museum series there are no males in retarded plumage for this or any of the following races.

The Loyalty Islands' population is actually intermediate between the populations of the southern New Hebrides and New Caledonia, and it is unfortunate that it was named instead of the New Hebrides bird. There is too much overlap between the two populations to separate the New Hebrides bird, but it seems worth while to record the differences. The general size is larger:

	WING	TAIL
Erromango		
♂ ad.	85–91	80–82.5
♀ ad.	85	76
Tanna		
♂ ad.	89	77–82
♀ ad.	81	—
Aniwa		
♂ ad.	91	78
♀ ad.	84–85	76
Aneiteum		
♂ ad.	85–86	76–81.5
♀ ad.	84	

New Hebrides birds thus measure, wing, ♂ ad. 85–91, against 82–88, tail 75–82.5, against 70–80. The white on the tail is still more reduced 11.5–17, against 14–19 in birds from the Loyalties. The rump is less whitish, in fact in 4 of the males it is almost pure gray. There is less white in the upper wing-coverts.

No differences could be found between specimens from the four mentioned islands.

Lalage leucopyga albiloris, new subspecies

TYPE.—No. 212817, Amer. Mus. Nat. Hist.; ♂ ad.; Efate I., New Hebrides; July 2, 1926; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *simillima*, but slightly smaller; rump more grayish; the lores are more or less white which in a good many individuals is carried on over the eye to form a pronounced superciliary stripe; median wing-coverts white, others largely black; white area on outer tail-feathers about the same (13–17.5).

The female agrees with the female of *simillima*, except that the lores are more prominently white and that there is in many examples a pronounced superciliary streak; rump more grayish; below slightly less tinged with buffy.

Tarsus 2 ♂ ad. 23–24; relative tail-length 93–97 per cent of wing-length.

	WING	TAIL
Efate		
1 ♂ ad.	82	76
Mai		
1 ♂ ad.	86	78
5 ♀ ad.	82-84	73.5-77
Tongoa		
1 ♂ ad.	85.5	80
1 ♀ ad.	83	74
Lopevi		
2 ♂ ad.	84, 86	81
3 ♀ ad.	78-82	72.5-78.5
Malekula		
7 ♂ ad.	81-87	76-84
1 ♀ ad.	79.5	74
Malo		
1 ♂ ad.	86	78
3 ♀ ad.	80-85.5	72-78
Espiritu Santo		
1 ♂ ad.	82.5	75
1 ♀ ad.	81	75

RANGE.—Central and northern New Hebrides: Efate, Lelepa, Mai, Tongoa, Epi, Lopevi, Pauuma, Ambrim, Malekula, Malo, and Espiritu Santo Isls.

The characters of this race are most pronounced on Efate I. Birds from the other islands show a distinct approach toward the following race by having the superciliary stripe less developed or absent. Individual specimens from the more northerly islands cannot be identified with certainty, but the series from these islands agree better with *albiloris* than with the Banks Islands race.

Lalage leucopyga deficiens, new subspecies

TYPE.—No. 216109, Amer. Mus. Nat. Hist.; ♂ ad.; Lo I., Torres Isls.; Nov. 5, 1926; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Similar to *albiloris*, but with less white on tail (8-16) and lacking any pronounced superciliary stripe; lores sometimes with an indication of white. Similar to *simillima* but with a somewhat longer tail in proportion to the wing, and a longer tarsus; rump grayer; white on wing-coverts much more restricted; much less white on tail. From *affinis* this race differs by the color of the rump which is grayish instead of white, and by having a great deal less white on the wing-coverts and more white on the tail. Tarsus 24-25; relative tail-length 91-94 per cent of wing-length.

	WING	TAIL
Mera Lava		
2 ♂ ad.	85.5, 87	77, 81
1 ♀ ad.	83	75

	Gaua	
2 ♂ ad.	81, 83	75, 76
3 ♀ ad.	81-85	71-77
Vanu Lava		
1 ♂ ad.	81	76
Valua		
2 ♂ ad.	83.5, 84.5	76, 78.5
2 ♀ ad.	80.5, 81	71, 74
Bligh		
1 ♂ ad.	81	71
Lo		
5 ♂ ad.	79-85	71-77
2 ♀ ad.	81, 82	73, 75.5

RANGE.—Torres and Banks Isls.

Of a series of 32 specimens in the American Museum's collection of *deficiens*, 4 ad. ♀ have a well-defined loreal spot, while 8 other birds (3 imm. ♂, 3 ad. ♀, and 2 imm. ♀) show the merest trace of white.

Lalage leucopyga affinis (Tristram)

Symmorphus (Lalage) affinis TRISTRAM, 1879. Ibis, p. 440.—Makira Harbour, San Cristoval I. SUBSPECIFIC CHARACTERS.—Differs from all the other races of *leucopyga* by having the smallest amount of white in the tail (1-4); the white on the rump is purer than in *montrosieri* or *simillima* and very much brighter than in *albiloris* or *deficiens*. There is no trace of a superciliary stripe. The amount of white on the wing is variable but about equal to *albiloris* and *deficiens*.

The brown on the upper parts of the adult female is paler than in any of the other races particularly on the forehead which in some cases is shaded with tawny-olive. Tarsus 23-25; relative tail-length: 83-88 per cent of wing-length.

	WING	TAIL
San Cristobal		
7 ♂ ad.	83-88	70-76
9 ♀ ad.	83-87	70-74
Ugi		
1 ♂ ad.	90	75
1 ♀ ad.	86	76

RANGE.—San Cristobal and Ugi, Solomon Isls.

A single male from Ugi is larger than any of the birds from San Cristobal, but a larger series is needed to confirm this difference.

It may be interesting to say a few words about the characters which in this species are subject to geographical variation: general size, body proportions (relative size of tarsus and tail), color of the rump (buffy, whitish, gray), amount of white on

tip of lateral tail-feathers and on upper wing-coverts, presence or absence of white loreal spot and superciliary, amount of buffy wash on under parts, presence or absence of a retarded male plumage, color of upper parts in female (pale or blackish brown),

etc. These ten characters have been used in the description given above of the geographical variation within this species. It is unknown whether or not there are any differences between the races in regard to habits and ecological requirements.

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NEW FOSSIL LEPORIDAE FROM MONGOLIA¹

By J. J. BURKE

The fossil Leporidae described in the following pages are represented in the collections of The American Museum of Natural History made by the Central Asiatic Expeditions under the leadership of Dr. Roy Chapman Andrews. It has been the privilege of the author to study and to describe this material from the Eocene and the Oligocene of Mongolia

through the courtesy of Dr. Walter Granger and the authorities of The American Museum of Natural History. The illustrations for this article are taken from the drawings of Mr. Sydney Prentice. The present study, carried out in the Graduate School of Duquesne University, was made possible by the writer's tenure of a Thornton Fellowship in Scientific Research.

ORDER DUPLICIDENTATA (LAGOMORPHA)

LEPORIDAE GRAY

Mytonolaginae, new subfamily

Lagomorphs with tooth formula of $I_1^1 C_0^0 P_3^3 M_3^3$; cheek teeth with roots and without cement. Terminal members of cheek tooth series functional. P_2 approximating M_1 in size; M_3 approximating P_3 or P_4 . M_1 the largest and most transverse of the superior cheek teeth; M_2 the largest and most transverse of the inferior cheek teeth. P_3 trilobate, with one external and two internal reentrants, its anterior lobe without grooves or furrows on its anterior face.

INCLUDED GENERA.—*Mytonolagus*, *Shamolagus*, new genus, and *Gobiolagus*, new genus.

KNOWN RANGE.—Upper Eocene, North America and Asia, Lower Oligocene, Asia.

SHAMOLAGUS,² NEW GENUS

GENOHOLOTYPE.—*Shamolagus grangeri*, new species.

DIAGNOSIS.—A genus nearly related to *Mytonolagus*, but less progressive in specialization; M_2 considerably exceeding M_1 in size, M_3 approximating P_4 in size. Lateral slopes of cheek teeth not as steep as in *Mytonolagus*. Protoconids of P_4 and M_1 tapering to the occlusal surface but showing hypertrophy and inflation toward the base of the crown.

Shamolagus grangeri,³ new species

Figure 1

HOLOTYPE.—A.M.N.H. No. 26289, a left mandibular ramus with P_4 , M_1 -3, incisor lost.

HORIZON.—Ulan Shireh, Upper Eocene. Ir-din Manha Beds.

LOCALITY.—Chimney Butte, North Mesa, Shara Murun Region, Inner Mongolia. Central Asiatic Exped., 1928.

DIAGNOSIS.—A smaller species than *Mytonolagus petersoni*, mandible more slender, of lighter construction throughout and narrowing anteriorly in front of M_2 . P_4 and M_1 apparently lower-crowned than in *Mytonolagus petersoni*, M_2 large, functional, with prominent third lobe.

In comparison with *Mytonolagus petersoni* of the North American Eocene, the present species is smaller, while the mandibular ramus is more slender and lighter. The diastema appears to have had nearly the same relative extent in both forms. The ramus of *Shamolagus grangeri* does not show the anterior depth of *Mytonolagus petersoni*, anteriorly the transverse narrowing of the ramus occurs just in advance of M_2 , whereas in the American species this narrowing begins just in advance of M_1 . The anterior mental foramen is located well in advance of P_3 in *Shamolagus grangeri* but is posterior to the mid-point of the diastema. A posterior mental foramen is

¹ Publications of the Asiatic Expeditions of The American Museum of Natural History, Contribution No. 143.

² From the Chinese Sha-mo—"sand desert," an old name for the Gobi, and the Greek λαγώς=hare.

³ The specific name is in honor of Dr. Walter Granger.

found beneath the anterior root of M_1 , posterior to its place in *Mytonolagus petersoni*. The slope of the ascending ramus is definitely lower than in *Palaeolagus* and in most species of *Desmatolagus*. There is a fairly shallow masseteric fossa, the inferior border of which is rounded, not sharp; anteriorly the ridge-like scar becomes a relatively large boss-like tubercle, larger than I have noted this structure in any other duplicitdentate species. Between the tubercle and the ascending wing of the ramus there is an area where the anterior border of the fossa is poorly defined, but its limits are sharply shown in relation to the ascending ramus. Beyond the fact that it is quite shallow and does not contain the foramen posterior to M_3 ,

but it is still a fair-sized tooth, functional, and with a prominent third lobe. The largest tooth in the row is M_2 ; the increase in size initiated here has not yet affected M_1 and the premolars to a comparable degree.

Although P_3 is lost, its alveoli indicate a tooth the base of which narrowed anteriorly. Apparently P_3 had a greater antero-posterior extent than P_4 , and was a little less transverse posteriorly. It seems to have been double-rooted, the roots arranged antero-posteriorly.

Judging from the relatively more transverse P_4 of *Shamolagus grangeri* and the gentler slope of its protomere walls when the tooth is compared with P_4 of *Mytonolagus petersoni*, that tooth in the Mongo-

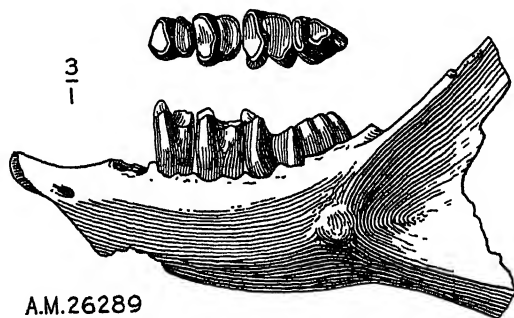


Fig. 1. *Shamolagus grangeri* Burke, holotype, A.M.N.H. No. 26289. Lateral view of mandibular ramus and occlusal view of P_4 , M_1 - M_3 left, $\times 3$.

the *sulcus ascendens* appears of the leporine type, and what is preserved of the plate representing the coronoid would indicate that the latter process was already well reduced in Upper Eocene lagomorphs. The dental foramen is large and slit-like, and obliquely directed, in contrast with its nearly vertical direction in *Palaeolagus*.

None of the incisor is preserved, and it is difficult to trace its former extent, but it is probable that it took its origin beneath M_2 .

The cheek teeth of the holotype contrast strongly with those of more recent lagomorphs. They are low-crowned, rooted, without cement, and, in proportion to the slender ramus, large and transverse. The reduction of M_3 has begun,

lian species was lower-crowned than P_4 of the American form. The molars of *Shamolagus grangeri*, with the exception of M_3 , were probably lower-crowned as well. In other respects P_4 of the present species differs rather sharply from the corresponding premolar in *Mytonolagus petersoni*. On the buccal side the trigonid wall expands rapidly toward the base, swelling out externally and posteriorly and crowding the talonid wall, which in turn narrows rootward. In P_4 of *Mytonolagus petersoni* there is not the marked external projection of the trigonid at the antero-external angle; there is less swelling of the trigonid wall and the talonid wall narrows less rapidly below. Also, in the Uinta Eocene form, the transition from crown to root on

the protomere is not indicated by any abrupt expansion of the crown, whereas in *Shamolagus grangeri* there is a decided buccal inflation of the tooth above the root. In occlusal section the trigonid of P_1 of *Shamolagus grangeri* has more of a pear-shape than that of *Mytonolagus petersoni*.

The "third lobe" of P_4 of *Shamolagus grangeri* is indicated by a notch at the postero-internal angle of the talonid. The implantation of the tooth is essentially as in *Mytonolagus petersoni*. There are two roots, antero-posteriorly arranged; the anterior root is compressed fore and aft.

In *Shamolagus grangeri* M_1 is a larger tooth than in P_4 and differs from the latter in the greater antero-posterior compression of its trigonid on the buccal side; this gives the trigonid a narrower occlusal section on the protomere and makes for a wider external valley in the tooth. From M_1 of *Mytonolagus petersoni* this tooth differs in showing gentler buccal wall slopes, greater projection at the antero-external angle, and more abrupt expansion of the crown wall above the roots. The talonid of M_1 of *Shamolagus grangeri* is larger, relative to the trigonid, than is the talonid of P_4 ; it is also larger, in this respect, than in M_1 of *Mytonolagus petersoni*. In M_1 of the Gobi species, as also in P_1 , the lingual reentrant is quite persistent, reaching well toward the base of the crown, as in the Uinta species. The two roots are arranged antero-posteriorly.

As mentioned above, M_2 is the largest of the check teeth, exceeding M_1 in both transverse and antero-posterior dimensions. The buccal wall of the trigonid is more compressed antero-posteriorly and is bent anteriorly; the anterior face of the trigonid bears a distinct groove on its protomere side. The external valley is wider than in M_1 and the talonid larger. Compared with M_2 of *Mytonolagus petersoni* the tooth shows greater extension and compression of the protomere wall of the trigonid, with the antero-external angle of the crown produced much farther buccally; there is a more prominent groove on the protomere side of the anterior face of the trigonid, while the external valley is wider

and the talonid larger, relatively, than in the Uinta Eocene species. A further difference is to be found in the roots of M_2 in the two forms; in *Shamolagus grangeri* the anterior and the posterior roots are separated; they are conjoined in *Mytonolagus petersoni*.

In size, M_4 approaches P_4 and is a larger tooth than the last molar in *Mytonolagus petersoni*. It shows more extension antero-posteriorly than M_3 of the American Eocene species and has a prominent talonid; there is, in addition to the main buccal valley, a postero-external valley marking off a large "third lobe." The internal valley is still indicated. The entire crown has not yet appeared above the alveolar wall in the holotype; the tooth appears to have been fully as high crowned as M_3 in *Mytonolagus petersoni*.

MEASUREMENTS

Shamolagus grangeri Burke, A.M.N.H. No. 26239
(holotype)

	mm.
P_2 antero-posterior, at alveolus	2 3
P_2 transverse, at alveolus	1 3
P_4 antero-posterior (occlusal surface)	1 9
P_4 transverse (occlusal surface)	1 6
P_4 transverse (at alveolus)	1 9
M_1 antero-posterior (occlusal surface)	2 0
M_1 transverse (occlusal surface)	2 1
M_1 transverse (at alveolus)	2 1
M_2 antero-posterior (occlusal surface)	2 3
M_2 transverse (occlusal surface)	2 3
M_2 transverse (at alveolus)	2 6
M_3 antero-posterior (occlusal surface)	1 8
M_3 transverse (occlusal surface)	1 5
M_3 transverse (at alveolus)	1 7
Length of inferior premolar series at alveoli (app.)	3 9
Length of inferior molar series (occlusal surface)	6 2
Length of inferior molar series (at alveoli)	7 6
Length mandibular tooth row at alveoli (app.)	10 7
Depth ramus under M_1 (lingual side)	6 9
Width superior region of ramus below M_2	3 3
Width superior region of ramus below M_1	3 1
Width superior region of ramus below P_4	2 6
Width superior region of ramus below P_2	2 2
Diastema between inferior I and P_2	5 8

Shamolagus medius,¹ new species

Figure 2

HOLOTYPE.—A.M.N.H. No. 26144, the anterior portion of a right mandibular ramus with broken incisor and P_2 -4, M_1 .

¹ The specific name is suggestive of its intermediate position between species of *Dremalinagus* and *Shamolagus*.

HORIZON.—Shara Murun, Upper Eocene.

LOCALITY.—Near Baron Sog, Inner Mongolia. Central Asiatic Exped., 1925.

DIAGNOSIS.—Near *Shamolagus grangeri* in size. Crown of P_3 trilobate at occlusal surface, with one external and two internal reentrants; anterior lobe sub-round in occlusal section, not compressed or grooved anteriorly. External valleys of P_1 and M_1 wider than in *Shamolagus grangeri*; talonid of P_4 more reduced, talonid of M_1 more triangular and trigonid of M_1 more compressed antero-posteriorly along the protomere.

The anterior part of the ramus which constitutes the holotype does not display any marked departures from that of *Shamolagus grangeri*, except that it shows somewhat greater fullness in the region of P_4 and M_1 , and its outline below these teeth suggests less expansion below M_2 than is found in the latter species. The two forms

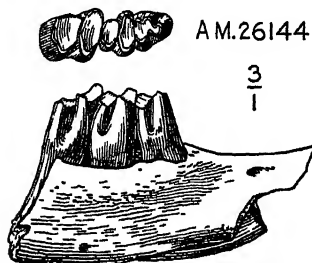


Fig. 2. *Shamolagus medius* Burke, holotype, A.M.N.H. No. 26144. Lateral view of the partial mandibular ramus and occlusal view of P_3-4 , M_1 right, $\times 3$.

are nearly the same in size and correspond fairly well in length of diastema. In *Shamolagus medius* both mental foramina are preserved; the anterior mental foramen has a more anterior position and is higher on the ramus than in *Shamolagus grangeri*.

The inferior incisor is flattened, or only slightly rounded anteriorly and extends posteriorly alongside the roots of M_1 ; it may have reached alongside the roots of M_2 .

Fortunately, P_3 is preserved in this specimen and is not badly worn. If the alveoli for P_3 of the holotype of *Shamolagus grangeri* can be depended upon as indicative of the antero-posterior dimensions of that tooth, the P_3 of *Shamolagus medius* is reduced in comparison with P_3 of the

genotypic species. This tooth, as preserved in the holotype, shows three reentrants, one external and two internal. The external reentrant is the most transverse and persistent; together with the antero-internal reentrant, which occurs well in advance of it, it delimits the prominent anterior lobe of the tooth. The anterior lobe is attenuated from below to the occlusal surface, particularly on the anterior and buccal sides, sub-round in occlusal section and apparently represents the trigonid. The lobe shows no definite evidence of flattening or grooving on the anterior face at this stage of wear.

The postero-internal reentrant occurs a little posterior to the external reentrant. It is less persistent than the antero-internal reentrant and has less transverse extent across the crown. The posterior wall of the talonid is flattened and compressed against the anterior face of P_4 ; the protomere pillar of the talonid is attenuated from the base upward. The tooth is strongly produced laterally at the postero-external angle. The enamel of P_3 is carried well down the anterior root.

In the holotype of *Mytonolagus petersoni* P_3 is too worn to furnish adequate comparison with this premolar in *Shamolagus medius*. However, P_3 of the Uinta Eocene species appears to have had steeper lateral and medial walls; the anterior lobe was relatively larger and the base of the crown was not produced laterally beyond the anterior lobe at the postero-external angle of the tooth.

From the corresponding tooth in *Shamolagus grangeri* P_4 differs in having a wider external valley, in showing a less swollen crown base, and in having the talonid reduced. In some respects the tooth shows an approach to P_4 of *Mytonolagus petersoni*, but P_4 of the Uinta Eocene species shows steeper lateral slopes, less inflation of the base of the trigonid, the inflation of the lateral crown base above the root is generally less marked, and the antero-external angle of the tooth is not produced laterally to such an extent. P_4 of the holotype of *Shamolagus medius* still shows a trace of the postero-internal reentrant.

The M_1 of *Shamolagus medius* shows a

wider external valley, greater antero-posterior compression of the lateral side of the trigonid, and less inflation of the crown base at the antero-external angle of the tooth than does M_1 of *Shamolagus grangeri*. The talonid is also larger and more triangular in the Shara Murun species. It is distinguished from M_1 of *Mytonolagus petersoni* by the same characters that differentiate P_4 in the two species.

exposure, P_4 and molars showing strong lateral hypertrophy of trigonids, M_{1-2} predominating over other mandibular cheek teeth in size. P_4 with modified *Shamolagus* pattern.

Gobiolagus tolmachovi,¹ new species

Figure 3

HOLOTYPE.—A.M.N.H. No. 26142, a left mandibular ramus with all the cheek teeth and a broken incisor.

REFERRED SPECIMEN.—A.M.N.H. No. 26143,

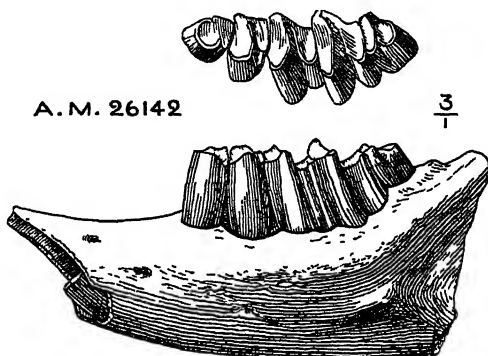


Fig. 3. *Gobiolagus tolmachovi* Burke, holotype, A.M.N.H. No. 26142. Lateral view of mandibular ramus and occlusal view of P_{4-4} , M_{1-2} left, $\times 3$.

MEASUREMENTS

Shamolagus medius Burke, A.M.N.H. No. 26144 (holotype)

	mm.
P_3 antero-posterior (occlusal surface).....	1.5
P_3 transverse (occlusal surface).....	1.2
P_3 transverse (at alveolus).....	1.3
P_4 antero-posterior (occlusal surface).....	1.7
P_4 transverse (occlusal surface).....	1.7
P_4 transverse (at alveolus).....	2.0
M_1 antero-posterior (occlusal surface).....	2.2
M_1 transverse (occlusal surface).....	2.2
M_1 transverse (at alveolus).....	2.1
Length of inferior premolar series at alveoli.....	3.4
Length of inferior premolar series at occlusal surface.....	2.8
Width superior region of ramus below M_1	3.2
Width superior region of ramus below P_4	2.8
Width superior region of ramus below P_3	2.0
Diastema between inferior I and P_3	5.5
Inferior I antero-posterior.....	1.5
Inferior I transverse.....	1.5

GOBIOLAGUS, NEW GENUS

GENEHOLOTYPE.—*Gobiolagus tolmachovi*, new species.

DIAGNOSIS.—Related to *Mytonolagus* and *Shamolagus*, but distinguished by marked unilateral hypsodonty and non-persistence of the internal valleys of the cheek teeth; talonid of P_4 reduced; talonids of P_{3-4} with slight lateral

a fragmentary left mandibular ramus preserving P_4 , M_{1-2} in shattered state. Anterior region of ramus missing.

HORIZON.—Shara Murun, Upper Eocene.

LOCALITY.—Near Baron Sog, Inner Mongolia. Central Asiatic Exped., 1925.

DIAGNOSIS.—Cheek teeth more hypsodont than in any other known Eocene duplicidentate; P_3 with main internal reentrant well in advance of external reentrant, as in *Shamolagus*. M_2 approaching P_4 in occlusal dimensions, but much less hypsodont. M_1 with somewhat, P_4 with definite pear-shaped occlusal section of trigonid. Talonid of P_4 weak. P_{3-4} characterized by slight lateral exposure of talonids, strong trigonids, groove-like external reentrants.

The mandibular ramus of the holotype indicates a species smaller than *Mytonolagus petersoni* but approaching *Shamolagus grangeri* in size. In depth (particularly in the anterior region) and in heaviness, the ramus falls short of that of the American form, but exceeds that in the species of *Shamolagus* in these respects. The diastema is somewhat greater than in *Shamolagus* and in *Mytonolagus*. The

¹ The specific name is given in honor of Dr. I. P. Tolmachoff.

ramus narrows transversely anterior to M_1 . In the holotype specimen there are two anterior mental foramina; the most anterior of the two is carried farther forward than in *Shamolagus medius*, while the posterior one occurs between the latter and P_3 , but lower on the ramus. The posterior mental foramen occurs under P_4 . The slope of the ascending ramus is steeper than in *Shamolagus grangeri*, the masseteric fossa is moderate, with better definition of the superior border than in the holotype of *Shamolagus grangeri*. The tubercle marking the apex of the fossa anteriorly is prominent but not comparable with the boss-like tubercle found there in *Shamolagus grangeri*. The dental foramen seems to have had more of a vertical direction than that of the latter species.

The mandibular incisor is triangular in transverse section, with the apex of the triangle posterior. Its anterior face is flattened or only a little rounded. The incisor was carried back under M_2 , as indicated by the incisive swelling.

The outstanding feature of the cheek teeth of *Gobiolagus* is hypsodonty, which quickly distinguishes them from those of *Shamolagus*. In this respect also they go beyond *Mytonolagus*. The hypsodonty is of the unilateral type, with the enamel carried well down the shaft on the lateral side; correlated with it is non-persistence of the internal valleys, which disappear after moderate wear. These features have their effect on the tooth pattern, and in particular on that of P_3 , but not enough to conceal its ultimate origin from a pattern which must have been much like that of P_3 of *Shamolagus medius*.

Another character of these teeth has its origin in hypertrophic development of the lateral side of the trigonids. This tendency has been mentioned in the case of *Shamolagus*, but it should be indicated that in *Mytonolagus* also, particularly in the premolars, the base of the trigonid shaft shows some hypertrophy. It may be that early lagomorph cheek teeth in general showed something of this tendency, but in *Shamolagus* and in *Gobiolagus* it is quite marked. In these forms we trace, first, marked inflation of the lateral base of the

trigonid; in a later sequence there follows antero-posterior compression of the trigonid shaft on the lateral side, which causes this element of the crown to jut laterally and out of proportion to the rest of the tooth.

The anterior cheek teeth of *Gobiolagus tolmachovi* are still in the first stage—that of hypertrophy of the lateral side of the trigonid. The posterior cheek teeth, on the other hand, have undergone the antero-posterior compression of the trigonid and show it jutting laterad.

The unique type of tooth row found in *Gobiolagus*, then, appears to be the result of a combination of two growth factors: hypertrophy of the lateral trigonid walls—a characteristic which *Gobiolagus* shares with *Desmatolagus* and to a lesser degree with *Mytonolagus*—and precocious (in a phylogenetic sense) unilateral hypsodonty. (Antero-posterior compression of the proto-mere walls is no unique feature, but appears to occur in all lagomorph lines.) Further individuality of the tooth row is due to a third factor, atrophy, displayed by the talonids of the premolars.

The P_3 of this species arises as a stout shaft, like a cylinder compressed transversely. In lateral view the cylindrical appearance is particularly striking. Postero-laterally the external reentrant is found; in the present specimen it extends but half the height from the occlusal surface to the alveolar border, and is in any case quite narrow and slit-like, extending a little more than a third of the distance across the crown surface at the present stage of wear.

On the median side is found the last trace of the antero-internal reentrant, here carried well in advance of the external reentrant. The two reentrants divide the crown into two lobes, an anterior, sub-round trigonid, without additional reentrants, and a posterior triangular talonid, which probably, at an earlier stage of wear, retained a postero-internal reentrant. The talonid shows little exposure on the lateral side—merely the apex of the triangle appears at the postero-lateral angle of the crown—but its median exposure exceeds that of the trigonid. The

tooth shows marked unilateral hypsodonty; the enamel extends down the lateral side beneath the alveolar border in the holotype specimen: on the median side of the crown the enamel descends more than half the height of the crown and is most persistent anteriorly.

The pattern is plainly a derivative of the type found in *Shamolagus medius*. There is no evidence of any division of the anterior lobe, and the deviations from the *Shamolagus* pattern shown in P_3 of the holotype of *Gobiolagus tolmachovi* are plainly due to the peculiar effects of progressive unilateral hypsodonty.

The P_4 of this species is a distinctive tooth. It shows the features of P_4 in the *Gobiolagus* line (hypertrophic growth of the trigonid and a weak talonid) but at the same time retains characters relating it to *Shamolagus*. The outjutting trigonid of this form is simply an exaggeration of the basal inflation of the trigonid seen in P_3 of *Shamolagus*, emphasized in the process of hypsodonty. The pear shape of the occlusal surface is a feature also found in P_4 of *Shamolagus*. What is distinctly a *Gobiolagus* character, however, is the slight development of the talonid, which appears compressed between the trigonids of P_4 and M_1 and has such a slight lateral exposure as to make the lateral side of the trigonid of P_4 appear the only functional part of the protomere of the tooth. To my knowledge this is the most distinctive feature of the *Gobiolagus* line—the diminutive size of the talonid of P_4 .

Among other characters of P_4 of this species which should be emphasized are the non-persistence of the internal valley and some median projection of the trigonid beyond the talonid. In A.M.N.H. No. 26143 the base of the tooth shaft is preserved; it shows the enamel extending down the lateral side of the shaft at a sharp angle. The tooth is rooted, and grooves would indicate that there are two roots, antero-posteriorly arranged.

The molars of this species resemble P_4 in that they show the hypertrophy of the trigonid and the lack of persistence of the internal valley, together with unilateral hypsodonty. The protomere sides of the

molar trigonids are not robust and rounded in section, however, but have undergone antero-posterior compression and jut laterad. Mediad they also project beyond the talonids to a degree. None of the talonids are of the diminutive type found in P_4 .

The M_1 of *Gobiolagus tolmachovi* somewhat resembles P_4 in preserving the pear-shaped occlusal section found in the latter. The trigonid has undergone antero-posterior compression to a much greater degree than in the latter tooth, though, and projects far lateral to the talonid. It is interesting to find that the pear-shaped occlusal section in M_1 of this species is more marked than in M_1 of *Shamolagus*. Although the talonid of M_1 of *Gobiolagus tolmachovi* is small, relative to the wide trigonid, it is not of the reduced type found in P_4 , and the external valley is wider. The discrepancy in size between P_4 and M_1 is marked, the molar is well in excess of the premolar in size.

The largest tooth in the row, as in *Mytonolaginae* generally, is M_2 , although it is not greatly in excess of M_1 in this case. Unlike the latter, the trigonid occlusal section has lost the pear shape and the protomere side of the trigonid is compressed antero-posteriorly. The external valley is wider than in M_1 . As in M_1 , the trigonid juts out laterally to a marked degree. My specimens do not show the number of roots in this tooth.

The M_3 of this species is smaller, in comparison with M_{1-2} , than in *Shamolagus grangeri* and *Mytonolagus petersoni*. Its trigonid is compressed antero-posteriorly, as is that of *Shamolagus grangeri*, but the talonid is sub-round in occlusal section. The M_3 of the holotype shows both the internal and the external reentrant valleys, but no trace of the "third lobe."

MEASUREMENTS

Gobiolagus tolmachovi Burke, A.M.N.H. No. 26142 (holotype)

	mm.
Inferior I, antero-posterior.....	1.5
Inferior I, transverse.....	1.3
P_3 antero-posterior (occlusal surface)....	1.4
P_3 transverse (occlusal surface).....	1.3
P_4 antero-posterior (occlusal surface)....	1.6

P_4 transverse (occlusal surface)	1 9
M_1 antero-posterior (occlusal surface) . . .	2 0
M_1 transverse (occlusal surface)	2 5
M_2 antero-posterior (occlusal surface)	2 1
M_2 transverse (occlusal surface)	2 8
M_3 antero-posterior (occlusal surface) . . .	1 4
M_3 transverse (occlusal surface)	1 8
Length of inferior premolar series at occlusal surface	3 1
Length of inferior premolar series at alveoli .	4 5
Length of inferior molar series at occlusal surface	5 5
Length of inferior molar series at alveoli . .	6 5
Length mandibular cheek teeth at occlusal surface	8 8
Length mandibular cheek teeth at alveoli . .	10 1
Depth ramus under M_1 (lingual side) . . .	7 5
Width superior region of ramus below M_2 .	4 0
Width superior region of ramus below M_1 .	4 0
Width superior region of ramus below P_1 .	3 5
Width superior region of ramus below P_2 .	2 5
Diastema between inferior I and P_3 . . .	7 1

A.M.N.H. No. 26097 from Twin Obo, East Mesa, Shara Murun Region, Inner Mongolia. Central Asiatic Exped., 1928.

DIAGNOSIS.—General construction much as in *Gobiolagus tolmachovi*, but P_3 more compressed transversely with main lingual reentrant more posterior (on worn teeth opposite buccal reentrant). P_4 somewhat exceeding M_3 in occlusal dimensions. Occlusal sections of P_4 and M_1 not pear-shaped. Protomere walls of cheek teeth steeper, more angular in occlusal section; talonids more transverse. Lateral exposure of talonids of P_{3-4} greater; lateral valleys of P_{3-4} wider.

As a whole, the mandibular ramus of the holotype of *Gobiolagus andrewsi* is larger than that of *Mytonolagus petersoni*; it is also deeper, although the ramus of the American form is relatively heavier. Compared with *Gobiolagus tolmachovi* the ramus

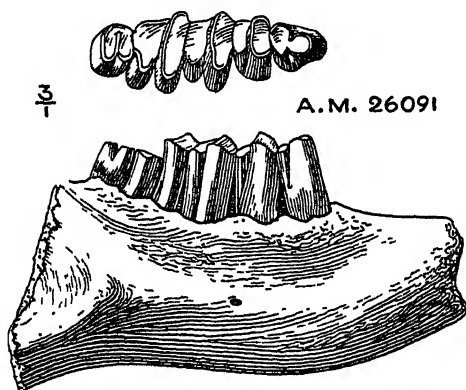


Fig. 4. *Gobiolagus andrewsi* Burke, holotype, A.M.N.H. No. 26091. Lateral view of mandibular ramus and occlusal view of P_{3-4} , M_{1-3} right, $\times 3$.

Gobiolagus andrewsi,¹ new species

Figure 4

HOLOTYPE.—A.M.N.H. No. 26091, a right mandibular ramus with all the cheek teeth and a broken incisor.

REFERRED SPECIMENS.—A.M.N.H. No. 26092, a right mandibular ramus with the incisor and P_{3-4} , M_{1-3} ; A.M.N.H. No. 26097, part of right mandibular ramus with the anterior portion missing but retaining a broken incisor, base of P_3 and P_4 , and M_{1-3} in place.

HORIZON.—Ulan Gochu, Lower Oligocene.

LOCALITIES.—Holotype, A.M.N.H. No. 26091 and referred specimen A.M.N.H. No. 26092 from Jhama Obo, East Mesa, Shara Murun Region, Inner Mongolia; referred specimen

is larger and deeper, but has about the same heaviness. The diastema is about the same as in *Gobiolagus tolmachovi*. The transverse narrowing of the ramus is abrupt in advance of M_1 , an approximation to the condition in *Mytonolagus*. The holotype shows an anterior mental foramen, somewhat atypical, in about the same situation as in *Gobiolagus tolmachovi*. Referred specimen A.M.N.H. No. 26092 shows a typical anterior mental foramen much like the anterior in *Gobiolagus tolmachovi*. The posterior mental foramen is found under P_4 . A.M.N.H. No. 26092 shows two posterior mental foramina in this vicinity. The masseteric fossa ap-

¹ The specific name is in recognition of the leader of the Central Asiatic Expeditions, Dr. Roy Chapman Andrews.

pears essentially as in *Gobiolagus tolmachovi*, although the tubercle directly anterior to it does not appear to have been as prominent as in that species.

The incisor of this species appears somewhat less angular than that of *Gobiolagus tolmachovi*, perhaps in this respect resembling that of *Mytonolagus petersoni*. The incisive swelling shows that the tooth took origin under M_2 .

In the holotype, P_3 is reminiscent of the same tooth in *Gobiolagus tolmachovi*. The tooth shows greater transverse compression, however, and is elongate antero-posteriorly; the trigonid is attenuated in an anterior direction, the anterior face of the tooth is less rounded. There are two reentrants preserved, as in P_3 of the holotype of *Gobiolagus tolmachovi*: in the holotype of *Gobiolagus andrewsi* both show greater extent across the crown, although they might approximate the condition found in the latter at a later stage of wear. The internal reentrant appears somewhat more persistent than in *Gobiolagus tolmachovi*. Both reentrant valleys are wider than those in P_3 of the latter species and are more nearly opposite; in comparison with P_3 of the Shara Murun Eocene species the antero-internal reentrant appears to have migrated posteriorly while the external reentrant has been carried anteriorly. Relative to the talonid, the trigonid is less prominent than in *Gobiolagus tolmachovi*; the talonid, while still triangular in occlusal view, shows less angularity and a greater lateral exposure. The holotype shows no postero-internal reentrant, but in A.M.N.H. No. 26092 an unworn P_3 shows it. The distribution of enamel on the shaft is much as in *Gobiolagus tolmachovi*; the tooth is unilaterally hypsodont, the enamel being carried down the shaft beneath the alveolar border on the lateral side, but the dentine is partly exposed on the median side. One specimen, A.M.N.H. No. 26097, preserves the base of the shaft of P_3 ; the tooth is double-rooted, with the roots arranged antero-posteriorly.

It is of interest, but not necessarily indicative of close relationship, that the pattern of P_3 of this species bears a strong resemblance to that found in P_3 of *Mega-*

lagus turgidus and *Megalagus intermedius*, except that the anterior lobe of the trigonid is not divided. The *Shamolagus* P_3 pattern appears to approximate the primitive pattern of lagomorphs in general.

The P_4 of *Gobiolagus andrewsi* shows specialization beyond that of *Gobiolagus tolmachovi* in the trigonid region. The pear-shaped occlusal section which characterizes the latter species and species of *Shamolagus* is no longer in evidence; in occlusal section the protomere approximates the paramere of the trigonid. This seems to have come about through antero-posterior extension of the trigonid on the paramere, coupled with compression on the protomere. The external valley is wider and the talonid has a greater lateral exposure but it shows little tendency toward an increase in size. A.M.N.H. No. 26097 shows an interruption of the enamel of this tooth on the anterior face toward the base of the shaft. The internal valley is of slight persistence: it appears to have been obliterated in the holotype, but is present in A.M.N.H. Nos. 26097 and 26092.

The molars in *Gobiolagus andrewsi* show greater antero-posterior compression of the trigonids on the protomere; they are in general less transverse with steeper protomere slopes and show relatively larger talonids. The talonids of these teeth have also expanded laterally and the alveolar border is more regular.

The M_1 of this species has lost the pear-shaped occlusal section which characterizes M_1 of *Gobiolagus tolmachovi* and both its trigonids and its talonids are compressed antero-posteriorly on the lateral side. The increase in size of the talonid is most apparent on the protomere. As in *Gobiolagus tolmachovi* this tooth considerably exceeds P_4 in size. A.M.N.H. No. 26097 shows this tooth rooted: apparently the anterior and posterior root canals are conjoined.

As in *Gobiolagus tolmachovi*, M_2 is the largest cheek tooth in the mandibular ramus. The M_2 of the holotype shows a larger talonid than does M_2 of the Shara Murun species, and its talonid shows a reentrant curve at the postero-external angle not shown in M_2 of *Gobiolagus tolmachovi*.

The increase in size of the talonid is most evident in the antero-posterior direction, although in lateral extent the base of the talonid approximates that of the trigonid. The M_3 of A.M.N.H. No. 26097 shows that this tooth is rooted, but while a strong groove appears on the shaft on the buccal side, the anterior and the posterior root canals are conjoined.

While, as in *Gobiolagus tolmachovi*, M_3 in this species is reduced in comparison with M_{1-2} , it is still a functional tooth. It shows a more transverse talonid than that found in M_3 of *Gobiolagus tolmachovi*. The holotype preserves the external valley, but not the internal, and shows indications

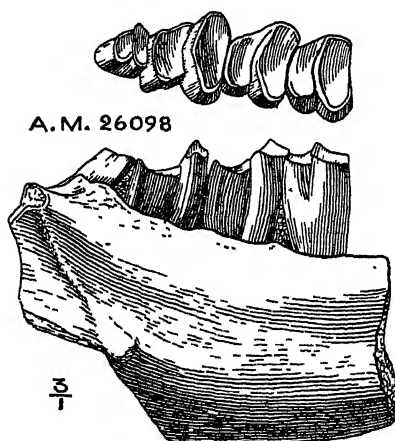


Fig. 5. *Gobiolagus (?) major* Burke, holotype, A.M.N.H. No. 26098. Lateral view of partial mandibular ramus and occlusal view of P_4 , M_{1-3} right, $\times 3$.

of the "third lobe" toward the base of the crown. A.M.N.H. No. 26097 shows the "third lobe" present as a tiny style on the posterior wall of the tooth, well below the functional occlusal surface of the crown. In A.M.N.H. No. 26097 the tooth is also shown as rooted, with distinct anterior and posterior root canals separated by a common wall.

MEASUREMENTS

Gobiolagus andrewsi Burke, A.M.N.H. No. 26091 (holotype)

	mm.
Inferior I antero-posterior.....	1.9
Inferior I transverse.....	2.0

P_3 antero-posterior (occlusal surface).....	1.7
P_3 transverse (occlusal surface).....	1.3
P_4 antero-posterior (occlusal surface).....	1.8
P_4 transverse (occlusal surface).....	1.7
M_1 antero-posterior (occlusal surface).....	2.0
M_1 transverse (occlusal surface).....	2.3
M_2 antero-posterior (occlusal surface).....	2.2
M_2 transverse (occlusal surface).....	2.5
M_3 antero-posterior (occlusal surface).....	1.3
M_3 transverse (occlusal surface).....	1.4
Length of inferior premolar series at occlusal surface.....	2.5
Length of inferior premolar series at alveoli.....	4.0
Length of molar series at occlusal surface.....	5.8
Length of molar series at alveoli.....	6.4
Length of mandibular cheek teeth at occlusal surface.....	9.1
Length of mandibular cheek teeth at alveoli.....	10.3
Depth ramus under M_1 (lingual side).....	8.3
Width superior region of ramus below M_2	3.9
Width superior region of ramus below M_1	3.5
Width superior region of ramus below P_4	2.9
Width superior region of ramus below P_3	2.0
Diastema between inferior I and P_3	7.0

Gobiolagus (?) major, new species

Figure 5

HOLOTYPE.—A.M.N.H. No. 26098, portion of a right mandibular ramus with P_4 , M_{1-3} and broken incisor.

HORIZON.—Ulan Gochu, Lower Oligocene.

LOCALITY.—Urtyn Obo, East Mesa, Shara Murun Region, Inner Mongolia. Central Asiatic Exped., 1928.

DIAGNOSIS.—Resembling *Gobiolagus (?) teilhardi*, new species, in heaviness of mandibular ramus and reduction of incisor, but a larger species. Cheek teeth much as in *Desmatolagus*, but P_1 of the *Gobiolagus* type.

The mandibular ramus of this species is at once characterized by its relatively great size and heaviness; in these respects it exceeds both *Desmatolagus robustus* and *Gobiolagus (?) teilhardi*, new species. The transverse narrowing of the ramus is anterior to M_1 ; in relative depth the ramus appears nearer *Gobiolagus tolmachovi* but is much heavier. The posterior mental foramen occurs beneath P_4 . The superior border of the masseteric fossa is shown sharply defined and rising about as steeply as in *Gobiolagus tolmachovi*. The tubercle anterior to the fossa is strong and boss-like, resembling that in *Shamolagus grangeri* although not as prominent as that in the latter. The dental foramen appears to have been much as in *Gobiolagus tolmachovi*.

The incisor in this form is small, in rela-

tion to the size of the ramus. It is more round, less trihedral than in *Gobiolagus tolmachovi*. This tooth extended back beneath M_1 at least, as indicated by the incisive swelling.

The P_3 is not preserved in the holotype and only specimen.

The P_4 is the most diagnostic tooth in the mandibular ramus; it points to an alliance of this particular species with *Gobiolagus* despite other atypical features of the dentition. The tooth shows atrophy—it is reduced in size in comparison with the molars; the characteristic small talonid of *Gobiolagus*, flattened against the trigonid and without a broad notch at the entrance of the lateral valley, is found here. It is true that the trigonid occlusal section does not have the pear-shape characteristic of the same section in P_4 of *Gobiolagus tolmachovi* but the section is not angular on the lateral side. The trigonid is prominent and appears sub-cylindrical, like a rounded peg, in lateral view, much as in *Gobiolagus andrewsi*; the lateral exposure of the talonid is slight, as in *Gobiolagus* generally. Laterally and medially the trigonid projects beyond the talonid.

Certain features suggest that the molars of this species (M_1 and M_2 at least) are not as advanced in specialization as those of *Gobiolagus tolmachovi* and *Gobiolagus andrewsi*. The ramus of this form is not as deep, indicating a shorter tooth shaft; the enamel of the internal side is persistent, although the teeth are well worn and the internal valley persists in M_1 even at this stage of wear—it shows in conjunction with the external valley in that tooth. These characteristics would indicate that *Gobiolagus (?) major* is not only a lower-crowned form than the latter species, but also shows less unilateral hypsodonty in its cheek teeth.

In general, the molars show less antero-posterior compression of the lateral sides of the trigonids than those of *Gobiolagus andrewsi*, thus resembling *Gobiolagus tolmachovi*. Although M_{1-2} are transverse, the trigonids show less lateral expansion than in the same molars in the above species. The trigonids also project medially beyond the talonids.

The M_2 is the largest cheek tooth in the ramus; its large talonid gives it the excess in size.

The M_3 is much reduced in comparison with M_2 ; it resembles that of *Gobiolagus tolmachovi* in showing the trigonid larger and more transverse than the somewhat rounded talonid. The tooth is rooted.

The molars of this species are suggestive of those of *Desmatolagus*, but the P_4 is definitely of the *Gobiolagus* type. Further evidence of affinity with *Gobiolagus* may be shown in P_3 when that tooth is known in this form. In the meantime, the evidence furnished by P_4 cannot be overlooked; this type of P_4 is not found in *Shamolagus*, which in every respect seems to stand ancestral to *Desmatolagus*. A further discussion of possible relationships of *Gobiolagus (?) major* is given in conjunction with the description of *Gobiolagus (?) teilhardi*, new species, which follows.

MEASUREMENTS

Gobiolagus (?) major Burke, A.M.N.H. No. 26998 (holotype)

	mm.
Inferior I, antero-posterior.	2.3
Inferior I, transverse	2.2
P_4 antero-posterior (occlusal surface).	2.6
P_4 transverse (occlusal surface)	3.3
M_1 antero-posterior (occlusal surface)	3.0
M_1 transverse (occlusal surface)	3.6
M_2 antero-posterior (occlusal surface)	3.1
M_2 transverse (occlusal surface)	3.5
M_3 antero-posterior (occlusal surface)	1.7
M_3 transverse (occlusal surface)	2.0
Length inferior molar series at occlusal surface	7.8
Length inferior molar series at alveoli	8.9
Depth ramus under M_1 (lingual side).	10.7
Width superior region of ramus below M_2	5.0
Width superior region of ramus below M_1	5.0
Width superior region of ramus below P_4	4.7

Gobiolagus (?) teilhardi,¹ new species

Figure 6

Duplicident indetermine TEILHARD, 1926, Annales de Paleontologie, Tome 15, Fig. 14C, p. 26.

HOLOTYPE.—A.M.N.H. No. 20236, a portion of a left mandibular ramus with broken incisor, base of P_3 and P_4 , M_1 .

HORIZON.—Hsanda Gol Red Beds, Upper Oligocene.

¹ The species is named for Pierre Teilhard de Chardin, who first described the form but refrained from giving it a specific name.

LOCALITY.—Ten miles west of Loh, Inner Mongolia. Central Asiatic Exped., 1922.

DIAGNOSIS.—Considerably larger than contemporary species of *Desmatolagus*; ramus heavier and deeper. Lateral walls of cheek teeth steeper and P_4 larger, relative to M_1 , than in *Gobiolagus andrewsi*; trigonid of P_4 more compressed antero-posteriorly on lateral side and lateral exposure of talonid of P_4 greater, but talonid of reduced type.

The fragmentary mandibular ramus which represents this species in the collection of The American Museum of Natural History indicates a lower jaw which is larger, deeper, and heavier than that of *Desmatolagus robustus*, with which it is

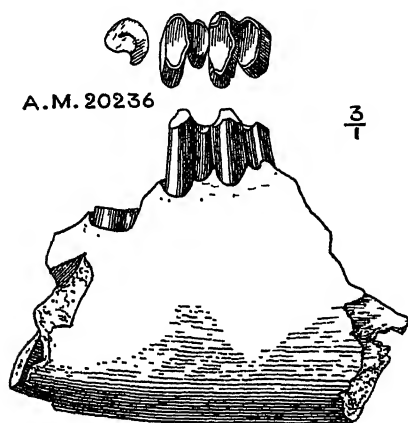


Fig. 6. (*Gobiolagus* (?) *teihardi* Burke, A.M.N.H. No. 20236. Lateral view of portion of mandibular ramus and occlusal view of broken P_3 and P_4 , M_1 left, $\times 3$.

associated in the Hsanda Gol fauna. The ramus shows no abrupt transverse narrowing in the vicinity of the anterior cheek teeth. There is a posterior mental foramen beneath and between P_3 and P_4 . The mandibular incisor is small, considering the size of the ramus. It shows little curvature on its anterior face and exhibits greater transverse compression than that of *Gobiolagus andrewsi*. The incisive swelling indicates that the tooth arose beneath M_1 .

The P_3 of this specimen is broken off at the alveolar border. The transverse section is comma-like, much as the worn occlusal section of the *Megalagus* P_3 , but the internal reentrant cuts into the tooth in

its posterior half, reducing the lateral exposure of the talonid. In the present condition of the tooth no other reentrants are discernible.

The P_4 is in a good state of preservation. The trigonid is stout, and in occlusal section the protomere area nearly approximates that of the paramere, but the lateral angle of the section is sharper than the median angle. The talonid, on the other hand, is small and shows slight lateral exposure in comparison with the trigonid—in general resembling the talonid of P_4 in *Gobiolagus tolmachovi* and *Gobiolagus andrewsi*—particularly the latter.

The M_1 shows a talonid approximating the trigonid in antero-posterior measurement, and the talonid contrasts further with that of P_4 in being considerably more transverse and in showing a greater lateral exposure; this comparison between P_4 and M_1 , it will be noted, holds true in *Gobiolagus tolmachovi* and *Gobiolagus andrewsi* also. The trigonid of M_1 is somewhat more compressed antero-posteriorly on the lateral side than in *Gobiolagus andrewsi*.

The cheek teeth of this species show steeper lateral walls than those of *Gobiolagus andrewsi*. In P_4 and M_1 the trigonids have greater lateral extent than the talonids, although in M_1 the talonid shows a greater lateral extent relative to the trigonid, than in *Gobiolagus andrewsi*. In both teeth the trigonids jut medially beyond the talonids to some degree. The internal valley is not persistent and is not preserved in the teeth of this specimen.

A most interesting feature of P_4 and M_1 of this species and one not found in these teeth in *Gobiolagus tolmachovi*, *Gobiolagus* (?) *major* and *Gobiolagus andrewsi*, is shown on the internal wall of the crown of each. There is a reentrant curve in the wall posterior to the internal reaches of the external valley. Within this vertical trough run two parallel grooves, with a delicate ridge between them. The origin of this ridge is not clear, in the absence of the internal valley, but it might represent a slight development of something in the way of a mesostyle. Some support for this hypothesis might be found in a specimen of *Desmatolagus robustus* in the Car-

negie Museum collection which shows a small tubercle in the exit of the internal valley of P_4 . Such a tubercle might persist, with hypsodonty, as a ridge, defined by grooves anterior and posterior to it.

The anterior wall of the alveolus for M_2 , as preserved in this specimen, is coated with a thick layer of cement.

Teilhard¹ has described a mandibular ramus which appears to represent this species; I am quoting his description for the benefit of other workers who may not have it at hand:

Cette mandibule, dont la face interne et les couronnes dentaires sont malheureusement trop altérées pour qu'on puisse fonder sur elle la description d'une espèce nouvelle, pourrait être confondue, à première vue, avec une mâchoire de *Desmatolagus robustus* dont elle a, à peu de chose près, la longueur dentaire ($P_3-M_2 = 10$ millimètres, au lieu de 11). Mais de cette espèce elle diffère, en réalité, par plusieurs caractères importants:

a. D'abord, chez elle, la branche horizontale de la mandibule est notablement plus profonde (10, 5 au lieu de 9).

b. Ensuite, P_3 est à croissance absolument continue, et plus longue (dans le sens antéro-postérieur) que P_4 .

c. Enfin, sur P_4 , le talon, au lieu d'être au moins aussi long que sur M_1 , est notablement plus court, moins détaché, plus arrondi que sur cette dent. A son tour, M_1 a un talon moins développé que M_2 . M_4 paraît relativement plus long, avec racines mieux séparées que sur les autres *Desmatolagus*.

Par la brièveté de sa P_4 et la longueur relative de sa P_3 , la mandibule que nous venons de décrire diffère, non seulement de *Desmatolagus robustus*, mais de tous les *Desmatolagus* que nous avons énumérés plus haut. Elle mériterait donc peut-être la création d'un genre spécial. Son mauvais état de conservation et le fait que sa P_3 ne présente, comme elle des *Desmatolagus*, que deux lobes (ou colonnettes) externes, au lieu de trois (comme celle des *Lagomys* et des *Leporidés*), nous décident à ne pas lui donner, au moins provisoirement, de nom nouveau.

The generic position of *Gobiolagus* (?) *teilhardi* must remain in some doubt until better material representing the species is available; when such material is studied, the species may prove to belong to a distinct genus. It is a temptation to propose the phylogenetic series *Gobiolagus tolmachovi* → *Gobiolagus andrewsi* → *Gobiolagus* (?) *teilhardi*: which may prove to be such,

but certain considerations make me hesitate in this case. For one thing, *Gobiolagus* (?) *teilhardi* has in common with the Ulan Gochu *Gobiolagus* (?) *major* a few characters (large size, heavy ramus, and disproportionately small incisor) which, although not usually given much phylogenetic weight, nevertheless are suggestive of relationship between these forms. It is true that *Gobiolagus* (?) *major* lags behind its contemporary *Gobiolagus andrewsi* in specialization, but my recent studies of species of *Desmatolagus* in the Hsanda Gol have shown me that in that genus the larger *Desmatolagus robustus* is persistently less specialized than the contemporary *Desmatolagus gobiensis*; it is possible that within the *Gobiolagus* group we have a somewhat similar situation, with greater specific disparity, in the Ulan Gochu.

MEASUREMENTS

Gobiolagus (?) *teilhardi* Burke, A.M.N.H. No. 20236 (holotype)

	mm.
Inferior I, antero-posterior.....	2.3
Inferior I, transverse.....	1.8
P_3 , antero-posterior at alveolus.....	2.0
P_3 , transverse at alveolus.....	2.0
P_4 , antero-posterior (occlusal surface)....	2.0
P_4 , transverse (occlusal surface)....	2.7
M_1 , antero-posterior (occlusal surface)....	2.4
M_1 , transverse (occlusal surface).....	2.8
Length of inferior premolar series at alveoli	5.4
Depth ramus under M_1 (lingual side).....	12.4
Width superior region of ramus below M_1 .	5.0
Width superior region of ramus below P_4 ...	4.8
Width superior region of ramus below P_4 ...	4.3

Desmatolaginae, new subfamily

Derivatives of *Shamolagus* paralleling the Megalaginae, but with generally less progressive cheek teeth and with terminal cheek teeth (particularly P_3) more reduced and simplified.

INCLUDED GENERA.—*Desmatolagus* and possibly *Amphilagus*.

RANGE.—Oligocene, Asia, ?Europe, and North America.

DESMATOLAGUS MATTHEW AND GRANGER

Desmatolagus vetustus, new species

Figures 7-8

HOLOTYPE.—A.M.N.H. No. 26089, a right mandibular ramus with complete dentition.

REFERRED SPECIMENS.—A.M.N.H. No. 26094, a left maxilla with P^3-4 , M^1-2 ; A.M.N.H. No. 26095, a right maxilla with P^3-4 , M^1-2 ; A.M.-

¹ Teilhard de Chardin, P., 1926, Descriptions des Mammifères Tertiaires de Chine et de Mongolie, Annales de Pal., Tome XV, p. 26.

N.H. No. 26093, a left mandibular ramus with complete dentition; A.M.N.H. No. 26099, a right mandibular ramus with all cheek teeth and broken incisor; A.M.N.H. No. 26083, a left mandibular ramus with cheek teeth complete, incisor broken; A.M.N.H. No. 26081, part of right mandibular ramus with P_{1-4} , M_1 ; A.M.N.H. No. 26082, part of left mandibular ramus with P_4 , M_{1-3} ; A.M.N.H. No. 26080, damaged right mandibular ramus with shattered P_1 , M_{1-2} and roots of P_3 ; A.M.N.H. No. 26090, a left mandibular ramus with P_4 , M_{1-2} .

HORIZON.—Ulan Gochu, Lower Oligocene.

LOCALITIES.—Holotype, A.M.N.H. No. 26089, and referred specimens A.M.N.H. Nos. 26093, 26094, 26095, and 26090 from Jhama Obo, East Mesa, Shara Murun Region, Inner Mongolia; referred specimens A.M.N.H. Nos. 26080, 26081, 26082, 26083, and 26099 from Twin Obo, East Mesa, Shara Murun Region, Inner Mongolia. Centr. Asiatic Exped., 1928.

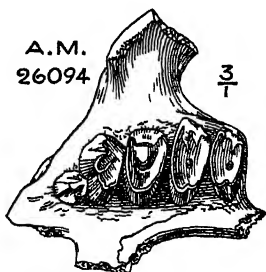


Fig. 7. *Desmatolagus vetustus* Burke, referred specimen. A.M.N.H. No. 26094. Ventral aspect of left maxillary with P^2-1 , M^{1-2} , $\times 3$.

DIAGNOSIS.—Distinguished from other species of *Desmatolagus* by: size (somewhat larger than *Desmatolagus gobiensis* but smaller than *Desmatolagus gazini*); lesser antero-posterior compression of cheek teeth; greatest width of maxillary tooth row usually at M^1 , of mandibular tooth row usually at M_2 ; P^2 rotund, not attenuate, less reduced; P^1 not compressed at antero-posterior angle; P^1 without notch between lateral cusps; attenuation of P_4 not marked, trigonid lobe of P_3 with anterior reentrant, but protoconid prominent; M_3^2 less reduced.

In addition to the holotype and several other mandibular rami, two maxillae are referred to this species. These specimens, A.M.N.H. Nos. 26094 and 26095, compare best in size with those of *Desmatolagus gobiensis* from the Hsanda Gol Oligocene, but are larger than the holotype maxilla of that species, and more robustly constructed. The Oreadon Beds Oligocene species *Desmatolagus gazini* is somewhat larger than the species under description,

but its holotype maxilla, though considerably damaged, would appear to be nearer that of *Desmatolagus vetustus* in relative heaviness. So, too, are the maxillae of the larger species of *Desmatolagus* of which we know—those of *Desmatolagus dicei* and *Desmatolagus robustus*, both of the latter showing the heaviness on the external side in the antorbital region which distinguishes *Desmatolagus vetustus* from *Desmatolagus gobiensis*. Both of these maxillae referred to *Desmatolagus vetustus* preserve the suture between the maxilla and the malar; the latter bone dove-tails with the maxilla and extends forward above the posterior part of P^3 . In lateral external view, the maxilla shows as a thin splint above the malar, but below the suture is more oblique and considerable of the maxilla is exposed. It is of interest that the suture is preserved in these specimens, in which the teeth are mature and well worn: I find the suture showing well in the holotype of *Desmatolagus dicei* also, and in that specimen the teeth are much worn. In all the specimens of *Desmatolagus gobiensis* and *Desmatolagus robustus* which I have examined, the suture is either obliterated entirely or in part.

The maxillary portion of the palatal bridge in *Desmatolagus vetustus* arises in advance of P^3 , which is in contrast with the situation in *Desmatolagus gobiensis*, where this portion of the bridge arises posterior to the alveolus of P^3 . However, in *Desmatolagus robustus*, which is the only other species represented by specimens preserving this region of the palate, the maxillary portion of the palatal bridge also extends farther anteriorly.

The P^2 of *Desmatolagus vetustus* is preserved in A.M.N.H. No. 26094. It is a relatively larger tooth than in *Desmatolagus gobiensis* generally, less attenuated, and swells more rapidly toward the base. In these respects it approaches to some extent the same tooth in *Desmatolagus robustus*, although P^2 of the latter is usually relatively smaller, and like that of *Desmatolagus gobiensis* shows a tendency toward flattening of the anterior face of the tooth and reduction of the paracone lobe.

P^3 in both maxillae of the species under

description lacks a protoloph, not even showing a short protoloph of the type found in the holotypes of *Desmatolagus dicei* and *Desmatolagus gazini*. It differs from P^3 of the latter forms also in showing a much more robust development at the postero-external angle, and in being more extended antero-externally, which gives it more of a triangular outline in occlusal view. However, neither of the North American species shows the compressed or pinched antero-external angle of P^3 which usually characterizes *Desmatolagus gobiensis* and which contrasts so strongly with the condition found in *Desmatolagus vetustus*. In general, the more triangular type of P^3 found in *Desmatolagus robustus* is more like that of *Desmatolagus vetustus* than the type of P^3 found in other species of *Desmatolagus*. The P^3 of *Desmatolagus robustus* also approaches that of *Desmatolagus vetustus* in failing to show marked reduction of the postero-external angle, but it differs from the latter, also from the American species and agrees with *Desmatolagus gobiensis*, in showing a better defined vertical groove on the anterior face in the region of the protocone.

P^4 , M^1 , and M^2 of the Hsanda Gol species of *Desmatolagus* show a tendency (most marked in *Desmatolagus gobiensis*) toward the development of a reentrant outer border between the trigon and talon external cusps. This is shown to some extent in the molars of the earlier Oligocene forms, including *Desmatolagus vetustus* but I have not noted it in P^4 of the Lower Oligocene species.

Neither P^3 nor P^4 of *Desmatolagus vetustus* is as transverse, i.e., extends as far externally, as do those teeth in the maxilla of the American species of *Desmatolagus* and the forms from the Hsanda Gol. When the superior tooth row of *Desmatolagus vetustus* is viewed at the occlusal surface, the external outline does not approximate a smooth curve, but is staggered and jagged anterior to M^1 . However, if one observes this outline of the maxillary tooth row in *Desmatolagus vetustus*, *Desmatolagus dicei*, and *Desmatolagus gazini*, *Desmatolagus robustus* and *Desmatolagus gobiensis* in the order named, he will ob-

serve that P^{3-4} gradually becomes more transverse on the external side, approximating each other and the molars, so that in the Hsanda Gol forms, this external outline of the tooth row, in occlusal view presents a fairly uniform curve from P^3 to M^3 , best shown in *Desmatolagus gobiensis* which in this, as in most other respects, is more specialized than its contemporary *Desmatolagus robustus*.

This increase in transverse extent carries with it, in P^4 at least, an increase in size which is also observable in the series, so that, while we find P^4 in *Desmatolagus vetustus* a tooth a little smaller than, or approximating M^1 in size, in the Hsanda Gol forms it is as a rule definitely the larger tooth.

I find little in the pattern of P^4 of *Desmatolagus vetustus* which might serve as a basis for specific distinction. Even the ectoloph-like external wall occurs as a variation in *Desmatolagus gobiensis*. In the two maxillae referred to *Desmatolagus vetustus* the internal reentrants are still preserved in P^3 and P^4 , but, as in other species of *Desmatolagus* there is no trace of the enamel island such as we find in *Palaeolagus*, although the island is present in M^{1-2} . In this respect, as in many others, *Desmatolagus* resembles *Magalagus* and *Mytonolagus*.

The M^1 and M^2 of *Desmatolagus vetustus* appear to differ from the same teeth in later Oligocene forms, and notably from *Desmatolagus gobiensis* in being less compressed antero-posteriorly, and in showing lesser delicacy and sharpness of the pattern elements. It is also worthy of note that in M^{1-3} of *Desmatolagus vetustus* the internal reaches of the external valleys have been obliterated by wear, although the enamel island still remains. This is in contrast to the condition found in *Desmatolagus gobiensis* where the inner reaches of the antero-external valley persist, together with the island, even after the external course of the valley has been obliterated.

M^3 of *Desmatolagus vetustus* does not show an unusually short postero-external crest of the type found in *Desmatolagus gazini*. However, as the penultimate cheek tooth, M^2 in these forms can be ex-

pected to show rather considerable variation, and I doubt whether this short crest will prove a constant specific character in *Desmatolagus gazini*.

Neither of the two maxillae referred to *Desmatolagus vetustus* preserves M^3 , but the alveolus for this tooth is shown in both cases, and its size suggests that the tooth was less reduced than in later Oligocene forms.

While in point of size the mandible of *Desmatolagus gobiensis* comes nearest that of the species under description, although a little smaller, it is in full accord with the maxilla of that species in lacking the heaviness found in *Desmatolagus vetustus*. In this respect, again as was noted under

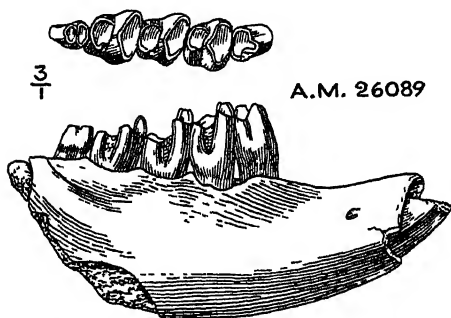


Fig. 8. *Desmatolagus vetustus* Burke, holotype, A.M.N.H. No. 26089. Lateral view of mandibular ramus and occlusal view of P_{2-4} , M_{1-3} right, $\times 3$.

the description of the maxilla, *Desmatolagus vetustus* makes an approach to *Desmatolagus robustus* and *Desmatolagus dicei*. The diastema appears to be about the same as in the two Hsanda Gol species. In the holotype mandibular ramus of *Desmatolagus vetustus* the anterior mental foramen is located midway of the diastema, the posterior mental foramen beneath the talonid of P_4 ; in a paratype of *Desmatolagus gobiensis* the posterior mental foramen is somewhat, and the anterior mental foramen noticeably, posterior to these positions. Although there is considerable variation in regard to the placement of these foramina in both species, the tendency in *Desmatolagus gobiensis* seems to be in the direction of a more posterior loca-

tion. Two posterior mental foramina sometimes occur in *Desmatolagus vetustus* as in *Desmatolagus gobiensis*. In *Desmatolagus robustus* the anterior and the posterior mental foramina sometimes occur even anterior to their position in the holotype of *Desmatolagus vetustus*. The ascending ramus arises at a much steeper angle in *Desmatolagus gobiensis* than it does in *Desmatolagus vetustus*; the species under description again approaching *Desmatolagus robustus* in this respect, for the ascending ramus of the larger Hsanda Gol species also arises at a lower angle than that of *Desmatolagus gobiensis*. A.M.N.H. No. 26083, referred to *Desmatolagus vetustus*, preserves enough of the dental foramen to show the latter as slit-like and extended nearly vertically, as in later species of *Desmatolagus*, rather than obliquely, as in *Shamolagus grangeri*. In the specimens of *Desmatolagus vetustus* at hand, the masseteric fossa is not well preserved except in A.M.N.H. No. 26083, which is a young specimen, but from what I can make out of it in the older specimens, it was not as deeply excavated as in the Hsanda Gol forms of *Desmatolagus*, and it did not have its antero-dorsal boundary as sharply defined. The present species is somewhat larger than *Shamolagus medius*, the Eocene form with which it compares best, and from which it appears to be derived. The Ulan Gochu species shows a little increase in depth and heaviness of the ramus anteriorly, but the principal differences of note are to be found in the cheek teeth.

The mandibular incisor of this species is trihedral in cross-section, with a flattened anterior face. It arises beneath M_1 and is larger than that of *Shamolagus medius*. It seems to present no salient characters distinguishing it from the lower incisors of other species of *Desmatolagus*.

The P_3 of *Desmatolagus vetustus* is a stout tooth, a crudely cylindrical peg, expanding somewhat toward the base anteriorly and laterally. There is a single external reentrant which extends less than half the distance across the occlusal surface of the tooth in the holotype. In the holotype also the anterior face of this tooth is broadly concave on its lingual side

but the reentrant thus indicated is somewhat less persistent than the external reentrant. This is the usual pattern shown in P_3 of mature specimens of *Desmatolagus vetustus*; no other reentrants show at this stage of wear and the shaft is tri-lobed at the occlusal surface.

This, in its essentials, is the worn *Desmatolagus* P_3 pattern. I am strongly inclined to believe that it has not been derived from the P_3 pattern of *Shamolagus* without marked modification. There is a mandibular ramus of a young specimen of *Desmatolagus vetustus*, A.M.N.H. No. 26083, which preserves P_3 at an early stage of wear; in this specimen the broad anterior reentrant is shown, as in the holotype, but posterior to it, on the lingual side and anterior to the external reentrant is a third reentrant, not as persistent as either of the former. This could represent either one of the two internal reentrants of P_3 of *Shamolagus*—the antero-internal or the postero-internal, but I am interpreting it as the antero-internal because it resembles that reentrant as it usually appears in P_3 of the *Duplicidentata*, because it arises in advance of the external reentrant, and because the postero-internal reentrant is least persistent in *Shamolagus* and might be expected, in view of the compression of the talonid found in *Desmatolagus*, to be eliminated from the crown surface.

If this interpretation is correct, however, we must conclude that the anterior lobe of P_3 of *Desmatolagus* is only homologous in part with that of P_3 of *Shamolagus*: to put it in another way, the trigonid lobe of *Shamolagus* is undivided—in *Desmatolagus* the trigonid lobe is divided by an anterior reentrant corresponding to an anterior valley. There are indications that "molarization" of P_3 (sub-division of the trigonid) has been attained by most duplicidentates during the Oligocene, as shown in *Palaeolagus*, *Megalagus*, and *Titanomys*, even though in some cases it shows as little more than a flattening of the anterior face of the trigonid.

The modification of the trigonid in P_3 of *Desmatolagus vetustus* from the condition found in P_3 of *Shamolagus medius* has drawn the anterior wall of the external re-

entrant valley mediad, widening the latter valley and giving considerably more exposure of the lateral talonid wall in anterior view. The lateral side of the talonid is also more compressed antero-posteriorly than in P_3 of *Shamolagus medius* and its lateral wall is steeper.

The P_3 of *Desmatolagus robustus* shows less attenuation than that of *Desmatolagus gobiensis*, however, and the unworn pattern may resemble that of *Desmatolagus vetustus*.

A.M.N.H. No. 26080 shows this tooth to have been double-rooted, with the roots arranged antero-posteriorly.

The principal differences between P_3 of *Desmatolagus vetustus* and the same tooth of *Desmatolagus gobiensis* consist in greater attenuation of the tooth shaft in the Hsanda Gol species, which carries with it less marked expansion of the tooth toward the crown base, and steeper crown walls, particularly anteriorly and externally; some transverse compression of the anterior lobe and antero-posterior compression of the talonid—the latter exhibited in the sharp external talonid wall, the flattening of the posterior wall against P_4 , and the antero-posterior reduction of the talonid on the internal side. This reduction of the talonid on the internal side seems to be due to a great extent to the continued widening and shallowing of the anterior reentrant; the latter often appears more like a wide plane face, rather than a groove, on the antero-lingual side of P_3 of *Desmatolagus gobiensis*. Perhaps the most noticeable features of P_3 of *Desmatolagus gobiensis* in contrast with that tooth in *Desmatolagus vetustus* are the greater attenuation of the tooth in the Hsanda Gol species, and the wider groove or face at the antero-lingual angle.

Prevalent in many specimens of *Desmatolagus gobiensis* but not shown in any of the specimens of *Desmatolagus vetustus* at hand is the development of a tubercle at the base of the antero-internal reentrant valley.

As might have been expected, considering other similarities in the two forms, the P_3 of *Desmatolagus robustus* makes a much closer approach to that of *Desmatolagus*

vetustus than does P_2 of *Desmatolagus gobiensis*. In fact, the only differences, outside of size, which appear to me as consistently distinguishing the two are shown in the greater attenuation of the tooth shaft, lesser expansion toward the base of the crown, and steeper walls; also the greater persistence of the external reentrant, in *Desmatolagus robustus*.

The P_4 of *Desmatolagus vetustus* is a relatively larger tooth than that of *Shamolagus medius*. The tooth is less attenuate from the base to the crown surface on the external side; the external walls of the trigonid and the talonid are steeper; the trigonid is less swollen toward the base on the protomere side, the transition from crown to root is less abrupt, and the enamel has extended further down the trigonid root on the lateral side. The trigonid, laterally, no longer crowds the talonid toward the base of the crown to the extent that it did in *Shamolagus medius*; while the talonid shows more expansion toward the base on that side. Seen at the occlusal surface, the talonid is larger than in *Shamolagus medius* and sub-round in outline, not triangular as in *Shamolagus medius*; the trigonid is more compressed antero-posteriorly, particularly on the protomere side, its occlusal surface showing less of the pear-shaped outline. The external valley is wider.

When comparison is made with P_4 of *Desmatolagus gobiensis*, P_4 of *Desmatolagus vetustus* is seen to approximate that tooth in *Shamolagus* in the rotundity of the lateral side of its trigonid and its preservation of something of the pear-shaped trigonid occlusal section. The P_4 of *Desmatolagus gobiensis* is a more hypsodont tooth, with steeper walls and more angular occlusal sections; the trigonid is compressed antero-posteriorly and the talonid shows a triangular, rather than a sub-round occlusal section. Its reentrant valleys are also narrower and less persistent, and the external valley is V-shaped. In regard to its "molarization" stage, the tooth probably makes its nearest approximation to *Desmatolagus dicei*. It is interesting that *Desmatolagus dicei* also shows the small P_4 (M_2 is the largest mandibular cheek tooth

in that species). The greatest width of the mandibular tooth row is usually at M_2 in *Desmatolagus vetustus* also, although I have found one exception to this, A.M.N.H. No. 26090, a mandibular ramus of a young individual showing the greatest width of the tooth row at P_4 . In *Desmatolagus robustus* P_4 appears to be consistently the widest tooth.

A.M.N.H. No. 26080 indicates that this tooth was double-rooted.

One specimen, A.M.N.H. No. 26099, shows a P_4 which has revolved 90° in the ramus, with the trigonid medial in position and the talonid lateral. Judging from the wear on the tooth I think it must have functioned in this position during the animal's lifetime.

In general, in comparison with *Desmatolagus gobiensis*, many of the differences pointed out in the discussion of the fourth premolars of the two species hold true for the molars as well. The M_1 of *Desmatolagus vetustus* differs rather strikingly from the M_1 of *Shamolagus medius* in showing the sub-round, rather than triangular talonid occlusal section; the talonid is also reduced in size when compared with that of the latter species. But the molars of *Desmatolagus vetustus* still approximate the type found in *Shamolagus* in being relatively low-crowned with persistent internal valleys, whereas in *Desmatolagus gobiensis* the teeth are more hypsodont and the internal valleys less persistent. In the latter species, too, the molars have undergone more antero-posterior compression, the lateral protomere walls are more angular, the external valleys are V-shaped and the talonids are triangular, rather than sub-round in occlusal section. In the above assemblage of characters *Desmatolagus robustus* approximates *Desmatolagus vetustus* more nearly than *Desmatolagus gobiensis* does; it shows less antero-posterior compression of the molars and more persistent internal valleys. Nevertheless, in addition to greater size, the larger Hsanda Gol species shows the greatest width of mandibular tooth row at P_4 and greater reduction of M_3 than *Desmatolagus vetustus*. The M_3 is also reduced in *Desmatolagus dicei*, although the latter approaches

Desmatolagus vetustus in crown height and in having the greatest width of mandibular tooth row at M_2 ; it is, however, a much larger species.

The postero-internal reentrant marking off the "third lobe" is shown in P_4 and M_1 in A.M.N.H. No. 26090 and in the same teeth in A.M.N.H. No. 26083. The M_2 of the latter specimen also shows two distinct cusps, one lateral, the other medial, on the talonid.

MEASUREMENTS

Desmatolagus vetustus Burke, A.M.N.H. No. 26089 (holotype)

	mm.
Inferior I, antero-posterior.....	2.0
Inferior I, transverse.....	1.7
P_3 antero-posterior (occlusal surface).....	1.2
P_3 transverse (occlusal surface).....	1.6

A.M.N.H. No. 26094 (referred specimen)	
P^2 antero-posterior (occlusal surface).....	0.9
P^2 transverse (external border to inner edge of occlusal surface).....	1.2
P^2 transverse (external border to inner alveolar margin).....	1.5
P^3 antero-posterior (occlusal surface).....	1.4
P^3 transverse (external border to inner edge of occlusal surface).....	2.6
P^3 transverse (external border to inner alveolar margin).....	3.3
P^4 antero-posterior (occlusal surface).....	2.1
P^4 transverse (external border to inner edge of occlusal surface).....	3.1
P^4 transverse (external border to inner alveolar margin).....	4.0
M^1 antero-posterior (occlusal surface).....	2.1
M^1 transverse (external border to inner edge of occlusal surface).....	3.6
M^1 transverse (external border to inner alveolar margin).....	4.3
M^2 antero-posterior (occlusal surface).....	1.7

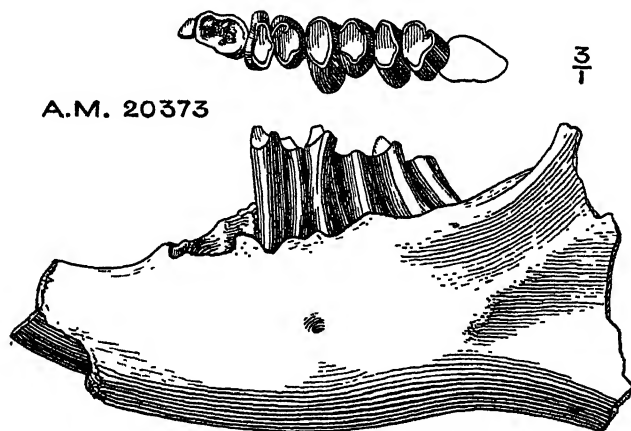


Fig. 9. *Desmatolagus ardynense* Burke, holotype, A.M.N.H. No. 20373. Lateral view of mandibular ramus and occlusal view of P_4 , M_{1-2} left, $\times 3$.

P_1 antero-posterior (occlusal surface).....	2.1	M^2 transverse (external border to inner edge of occlusal surface).....	2.8
P_1 transverse (occlusal surface).....	2.6	M^2 transverse (external border to inner alveolar margin).....	4.2
M_1 antero-posterior (occlusal surface).....	2.1	Length of superior premolar series (at occlusal surface).....	4.3
M_1 transverse (occlusal surface).....	2.2	Length of superior molar series (at occlusal surface) (est.).....	4.0
M_2 antero-posterior (occlusal surface).....	2.1	Maxillary tooth row, alveolar measurement (est.).....	9.5
M_2 transverse (occlusal surface).....	2.4		
M_3 antero-posterior (occlusal surface).....	1.2		
M_3 transverse (occlusal surface).....	1.2		
Length of inferior premolar series at occlusal surface).....	3.1		
Length of inferior premolar series at alveoli.....	3.7		
Length of inferior molar series at occlusal surface).....	5.1		
Length of inferior molar series at alveoli.....	6.0		
Length mandibular tooth row at occlusal surface).....	8.4		

Desmatolagus ardynense, new species

Figure 9

Desmatolagus robustus MATTHEW AND GRANGER, 1925, Amer. Mus. Novit., No. 193, p. 7.

HOLOTYPE.—A.M.N.H. No. 20373, a left mandibular ramus with P_4 , M_{1-2} , anterior root of DP_3 , and broken incisor.

REFERRED SPECIMEN.—A.M.N.H. No. 20374, a right mandibular ramus with P_4 , M_{1-2} .

HORIZON.—Ardyn Obo, Lower Oligocene.

LOCALITY.—Ardyn Obo, Mongolia. Central Asiatic Exped., 1923.

DIAGNOSIS.—About the size of *Desmatolagus robustus* but with smaller P_4 ; cheek teeth less compressed antero-posteriorly. M_1 the largest mandibular cheek tooth.

In general proportions (size, relative heaviness, diastema, and depth of ramus) the mandibular ramus of this species would apparently fall within the range of *Desmatolagus robustus*. The ramus narrows transversely anterior to M_1 , however, in the holotype, which is of a young individual; in the referred specimen, from an old individual, the narrowing at this place is slighter. In *Desmatolagus robustus* the narrowing of the ramus seems usually to occur anterior to P_4 . The anterior mental foramen is carried forward and occurs at the incisive region of the diastema in the young holotype specimen. The posterior mental foramen lies between and beneath P_4 and M_1 (in A.M.N.H. No. 20374 just beneath the talonid of P_4). The slope of the ascending ramus is not as steep as in *Desmatolagus robustus* and *Desmatolagus dicei*. The masseteric fossa is very shallow in the young holotype specimen, but shows moderate development in A.M.N.H. No. 20374. The scar is not as distinct as in *Desmatolagus robustus* and *Desmatolagus dicei*, but in A.M.N.H. No. 20374 the tubercle anterior to the scar is a little reminiscent of that in *Shamolagus*. The slit of the dental foramen is more oblique than in *Desmatolagus robustus*.

The incisor of A.M.N.H. No. 20373 seems less angular in cross-section than that of *Desmatolagus robustus* but this may be a character dependent upon the stage of growth. The incisive swelling, however, indicates that the incisor extended posteriorly beneath M_1 , whereas in *Desmatolagus robustus* the incisor does not appear to extend posterior to P_4 .

P_3 is not preserved, but its alveolus suggests that it was larger than P_3 of *Desmatolagus robustus*. Anterior to the alveolus appears the base of the root of DP_3 ; this

is the "minute vestigial stump of a tooth" mentioned by Matthew and Granger.¹ This is plainly the remnant of the anterior root of the milk tooth, not a vestige of P_3 .

The cheek teeth, in general, show less antero-posterior compression than those of *Desmatolagus robustus*.

The P_1 is relatively a smaller tooth than in *Desmatolagus dicei* and much smaller than in *Desmatolagus robustus*, where P_1 is "molariform" and as large as, or larger than M_1 . P_4 in the holotype preserves the postero-internal reentrant marking off the "third lobe."

The M_1 is the largest and most transverse of the mandibular cheek teeth. This contrasts with the situation in *Desmatolagus robustus* where M_1 is sometimes smaller than P_4 or M_2 . In *Desmatolagus dicei* M_2 is the largest of the mandibular cheek teeth and the most transverse.

The M_2 in the holotype of *Desmatolagus ardynense* preserves the postero-internal reentrant.

The alveolus for M_3 suggests that the tooth was larger than in *Desmatolagus dicei* or *Desmatolagus robustus*.

Desmatolagus ardynense is apparently little advanced beyond *Desmatolagus dicei* in specialization but is definitely less specialized than *Desmatolagus robustus*; it probably gave rise to the Hsanda Gol species.

MEASUREMENTS

Desmatolagus ardynense Burke, A.M.N.H. No. 20373 (holotype)

	mm.
P_3 alveolus, antero-posterior.....	2.6
P_3 alveolus, transverse.....	2.0
P_4 antero-posterior (occlusal surface)....	2.2
P_1 transverse (occlusal surface).....	2.0
M_1 antero-posterior (occlusal surface)....	2.8
M_1 transverse (occlusal surface).....	2.4
M_2 antero-posterior (occlusal surface)....	2.9
M_2 transverse (occlusal surface).....	2.4
M_3 alveolus, antero-posterior.....	2.2
M_3 alveolus, transverse.....	1.8
Length of inferior premolars at alveoli (app.).....	5.5
Length of inferior molars at alveoli (app.)..	8.5
Length mandibular tooth row at alveoli (app.).....	14.2
Depth ramus under M_1 (lingual side).....	9.7

¹ Matthew, W. D., and Granger, Walter, 1925, "New Creodonts and Rodents from the Ardyn Obo Formation of Mongolia." Amer. Mus. Novit., No. 193, p. 7.

Width superior region of ramus below M_2 . . . 4.7
 Width superior region of ramus below M_1 . . . 4.9
 Width superior region of ramus below P_4 . . . 4.3

Width superior region of ramus below P_3 . . . 3.6
 Inferior I, antero-posterior 2.4
 Inferior I, transverse 2.0

SUMMARY

There are now represented, in the Upper Eocene, three genera of Leporidae—*Mytonolagus* in North America, *Shamolagus*, and *Gobiolagus* in Asia. *Gobiolagus* is also found in the Lower Oligocene of Mongolia. These genera have in common certain features of the cheek teeth—presence of roots, general pattern, and molar-premolar proportions, plus an undivided trigonid lobe of P_3 —which in combination are not found in later Leporidae. For this reason I have grouped the three genera in a common subfamily, the Mytonolaginae. Since the characters delimiting the Mytonolaginae will probably apply to an Upper Eocene and Eocene-Oligocene transition stage in the evolution of the Leporidae generally, the group will likely prove to include the stem stock of all later Leporidae.

The genus *Shamolagus* approximates the North American *Mytonolagus* in many respects, but differs from the latter mainly in showing more brachyodont anterior cheek teeth and a characteristic construction of the trigonids. The exceptionally large M_3 of *Shamolagus grangeri* will probably not be found in *Shamolagus medius* from the Ulan Shireh Beds, which are apparently older than the Myton Member of the Uinta Eocene in which *Mytonolagus petersoni* is found, and the smaller M_1 which characterizes the American Upper Eocene species will probably be approximated in *Shamolagus medius* which is derived from the Shara Murun Eocene, a geologically younger formation than the Ulan Shireh.

In P_4 of the holotype of *Shamolagus medius* we find P_3 preserving its full complement of reentrants; the tooth in this specimen demonstrates that in that genus the trigonid lobe of P_3 is without grooves or reentrants.

Contemporaneous with *Shamolagus medius* in the Shara Murun is *Gobiolagus tolmachovi*, representing the second genus

of the Leporidae in the Mongolian Upper Eocene. *Gobiolagus* differs from *Shamolagus* and *Mytonolagus* in showing marked unilateral hypsodonty and a reduced P_4 characteristic of the genus.

In the next higher horizon recognized in Mongolia, the Ulan Gochu Lower Oligocene, *Gobiolagus andrewsi* appears to be an immediate descendant of *Gobiolagus tolmachovi*. Fortunately one specimen of this species in the present collection shows P_3 in an early stage of wear, and agrees with the holotype of *Gobiolagus tolmachovi* (in which P_3 is worn, however) in showing the trigonid lobe to be without grooves or reentrants.

In the Ulan Gochu Lower Oligocene there occurs a large and aberrant species, *Gobiolagus* (?) *major* which combines cheek teeth in general much like those of *Shamolagus* and *Desmatolagus* with a P_4 of the *Gobiolagus* type. The true affinities of this form remain to be demonstrated; the P_3 is lacking in the unique holotypic specimen.

Before entering into a discussion of a third Ulan Gochu form, I think it best to point out the evolutionary lines present in the Mytonolaginae. As we have seen, the unilaterally hypsodont *Gobiolagus* is already represented by a sequence of two species and possibly by another but aberrant form. In the North American Upper Eocene occurs *Mytonolagus*, a form somewhat intermediate between *Shamolagus* and *Gobiolagus* in its specialization. *Shamolagus*, in the Mongolian Eocene, is represented by two species. So far, these three genera conform to the Mytonolaginae as defined, but in their later specializations these evolutionary lines all appear to diverge too widely to be retained in the stem subfamily. *Mytonolagus*, for example, appears to be allied with the North American Oligocene *Megalagus*. *Gobiolagus* is related to an advanced species in the Hsanda Gol Upper Eocene. *Shamolagus* leads up

to *Desmatolagus*. To trace the later evolution of these stocks, already represented in the Megalaginae, the all-inclusive family term "Leporidae" is not adequate.

In an attempt to cope with this difficulty I propose to use subfamily names rather freely, an action opposed to my former practice, since I feel that taxonomic prefixes are often the prelude to taxonomic confusion. But the subfamily is already established as a major taxonomic unit in the Leporidae and I am trying to make the most of it.

The term Palaeolaginae, at least to the extent that it includes the species of *Palaeolagus*, is an extremely convenient one. I would not extend it, as Wood¹ has recently proposed, for by doing so, the utility of the term is lost; it must be remembered that the phyla of Oligocene Leporidae can be established on more characters than the pattern of P_3 alone. I have found no transitions between *Palaeolagus* and *Megalagus* in the Oligocene; the two generic lines seem quite distinct. For this reason I propose to utilize Walker's term, Megalaginae, to characterize the forms included in this genus, rather than my previous clumsy term of "turgidus group." Dice's term Archeolaginae might be extended to cover these forms, but it seems to me that the use of subfamily names to mark off evolutionary stages in the phyla of Leporidae also has its advantages—and gives rise to fewer wild surmises. The term Megalaginae might well be restricted to the Oligocene representatives of the *Megalagus* phylum which have rooted cheek teeth, among other characters, to distinguish them from later Leporidae.

For the *Desmatolagus* phylum, I am proposing a new subfamily, the Desmatolaginae, characterized by persistently unprogressive dentition and a tendency toward reduction and simplification of the terminal cheek teeth. The first representative of *Desmatolagus* is *Desmatolagus vetustus*, found in the Ulan Gochu Lower Oligocene of Mongolia. The form is the most primi-

tive and generalized of the genus, but is advanced beyond the Mytonolaginae in a very important respect; the anterior lobe of the trigonid of P_3 is divided by a broad anterior reentrant. From this species it is a fair conclusion that the anterior (or antero-lingual) reentrant of later species of *Desmatolagus* does not correspond to the main lingual reentrant valley, as might be supposed at first glance.

From a higher Lower Oligocene horizon than the Ulan Gochu, the Ardyn Obo, comes the second species of *Desmatolagus* described in the present paper—*Desmatolagus ardynense*. This large species is close to the Hsanda Gol form *Desmatolagus robustus* in specialization and is evidently ancestral to the latter.

In Asia the record of *Desmatolagus* is incomplete from the Ardyn Obo to the Upper Oligocene, but in North America *Desmatolagus dicei* in the Lower Oligocene and *Desmatolagus gazini* in the Middle Oligocene show increasing specialization of the genus. The record is completed in Asia in the Hsanda Gol Upper Oligocene where the genus culminates in species of the type of *Desmatolagus robustus* and *Desmatolagus gobiensis*.

Size and tooth pattern resemblances between *Desmatolagus vetustus* and *Desmatolagus gobiensis* suggest that there may be at least two evolutionary lines within the genus, the one represented by these smaller forms, more precocious in specialization, the other composed of larger, more conservative species including *Desmatolagus ardynense*, *Desmatolagus dicei*, and *Desmatolagus robustus*. The relationship of *Desmatolagus gazini* to these groups is not clear, although it appears to belong with the latter association.

After the Ulan Gochu Lower Oligocene, the record of the *Gobiolagus* stock is blank until we come to the Hsanda Gol Upper Oligocene. Here there occurs a large species, well specialized but with the characteristic reduced P_4 of the *Gobiolagus* stock. This form, *Gobiolagus* (?) *teihardi*, may well represent a new genus, and when known from more complete material will probably be excluded from the Mytonolaginae by virtue of advanced specializa-

¹ Wood, Albert, 1940, "Lagomorpha," Trans. Amer. Phil. Soc., New Series, XXVIII, Part III, p. 276.

tion. While there is abundant time for this large species to have evolved from the small and more typical species *Gobiolagus andrewsi* of the Ulan Gochu, it is suggested that *Gobiolagus* (?) *teihardi* might have descended from the aberrant *Gobiolagus* (?) *major* which also occurs in the Ulan Gochu and which tends toward *Gobiolagus* (?) *teihardi* in size, heaviness of mandibular ramus, and in incisor reduction.

I fail to find any close relationship between these Mongolian genera and the genus *Sinolagomys* of Bohlin¹ from Western Kansu. *Sinolagomys* presents an interesting combination of characters, as Bohlin has described and figured it, including a wide internal reëntrant valley in the superior cheek teeth, the prevailing direction of which appears to be antero-lateral. The mandibular molars show a deep channel extending down the lateral side of the anterior face of the trigonid and a persistent internal reëntrant; in the mandibular tooth row the molar talonids tend to extend medial to the trigonids posterior to them. Bohlin apparently could not derive

Sinolagomys from *Desmatolagus* (its contemporary) but suggested that the two forms had a common ancestry. However, the basic pattern of *Desmatolagus* is already present in *Shamolagus*, its Eocene ancestor; while these latter genera are relatively unprogressive and preserve various "primitive" duplicidentate characters, there seems little possibility that either might have given rise to *Sinolagomys*. *Gobiolagus*, a more progressive Mongolian genus, approximates even more decidedly the pattern of the modern Leporidae than *Shamolagus* and *Desmatolagus*, and likewise seems removed from possible ancestry of *Sinolagomys*.

In a previous paper² I have pointed out that the difference between the cheek teeth of the Ochotonidae and the Leporidae would seem to be chiefly a matter of pattern torsion; the two families appear to represent the extremes of divergent pattern trends. The derivation of the tooth pattern of the Ochotonidae from that of the Leporidae, while often inferred, remains to be demonstrated.

¹ Bohlin, Birger, 1937, "Oberoligozane Saugetiere aus dem Shargaltsein-Tal (Western Kansu)," *Palaeontologia Sinica*, New Series C, No. 3, Whole Series No. 107, pp. 7-66, Pls. 1-II, 136 figs.

² Burke, J. J., 1936, "*Ardynomys* and *Desmatolagus* in the North American Oligocene," *Ann. Car. Mus.*, XXV, pp 152-153.

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THE AFFINITIES OF THE BORHYAENIDAE

BY GEORGE GAYLORD SIMPSON

In several recent papers (e.g., 1939) there has been occasion to mention my belief that the South American fossil borhyaenids are not immediately and exclusively related to any Australian marsupials. The evidence against this view has been published in considerable detail (e.g., by Sinclair, Wood, Cabrera, etc., see below), but the evidence for it has not been adequately summarized. This note is published to give a review of opinions and evidence, as briefly as is consistent with showing that there is a strong, if not a conclusive, case for the belief elsewhere expressed without discussion.

The earliest literature on the subject was largely concerned with whether the borhyaenids, or "sparassodonts" as Ameghino called them, were marsupials or placentals, a question no longer requiring comment.

Ameghino's definitive views are summed up in his great work of 1906. Here he says that all more or less carnivorous animals belong to a single natural group, his *Sarcobora*, divisible into *Pedimana* (didelphoids), *Dasyura* (Australian carnivorous marsupials), *Insectivora*, *Sparassodonta* (South American carnivorous marsupials, *Borhyaenidae sensu lato*), *Creodonta*, *Carnivora* (*Fissipedia* of other authors), and *Pinnipedia*. Ameghino's accompanying diagram shows the *pedimanes* giving rise to the *sparassodonts* and *insectivores* and then, considerably later, to the *dasyures*. The *sparassodonts* give rise to the *creodonts* and these to the *pinnipeds* and *carnivores* (*fissipeds*). The *sparassodonts* are shown as derived from *pedimanes* quite independently of the *dasyures*. These two groups are, then, supposed to be parallel but not closely related, not, for instance, more closely than *sparassodonts* and *insectivores*.

Although it is now generally abandoned, Ameghino's belief in marsupial-creodont relationships was by no means erratic or ill-founded in his day. For instance, Wortman, then the greatest authority on creodonts, as Ameghino was on borhyaenids, held similar views. This is now a dead issue, but Ameghino's belief that borhyaenids and dasyurids were independently derived from didelphoids is still important.

Sinclair (1906) made a penetrating analysis and gave detailed descriptions of the Santa Cruz borhyaenids. He assumed, as all students would today, that the borhyaenids may be allied to the marsupials or to the creodonts, but not to both, and he listed twenty marsupial characters of the borhyaenids. He concluded that the borhyaenids were marsupials, a conclusion that has not since been seriously challenged. This, his essential argument, does not indicate (nor did he say it indicated) special relationship to dasyures or to thylacines, but he went on to say that such a relationship exists. The evidence for this opinion was, however, incompletely given. Sinclair did not explicitly discuss thylacinid as opposed to dasyurid or didelphid affinities. His definition of the *Thylacinidae* in order to include *Thylacinus* and the borhyaenids but to exclude dasyures and opossums does not, in fact, do this. It excludes opossums only by the incisor formula, variable in any case (and some didelphoids are not excluded by this character), and by the absence of the metaconid, really excluding many borhyaenids that he meant to include. The definition excludes dasyurids only by this same feature which is not really diagnostic of borhyaenids. Sinclair's subsequent discussion assumed that the borhyaenids were

thylacinids and pointed out more differences from, than resemblances to *Thylacinus*.

The status of the problem as left by Sinclair was thus that he had proved the borhyaenids to be marsupials and had expressed the opinion that they were thylacinids without making out a serious case for this subsidiary conclusion.

This opinion was widely accepted at the time and has been maintained by many students ever since, but it was seriously questioned by Matthew (1915), who showed what I have mentioned above, that Sinclair had not really offered any evidence of thylacinid (as opposed merely to polyprotodont marsupial) affinities. He pointed out that the resemblance between borhyaenids and thylacines is no closer than has unquestionably arisen by parallelism from an undifferentiated ancestry in analogous cases among true carnivores. Matthew concluded that there was no evidence that this supposed relationship was closer than would be implied by derivation from primitive marsupials didelphid in structure.

Although he did not so put it, Matthew thus was supporting Ameghino's view of the parallel, not direct, relationships between borhyaenids and thylacinids plus dasyurids, while accepting Sinclair's important emendation that made all these forms marsupials not allied to the creodonts.

Wood (1924) made a thorough review of the specific problem of the position of the borhyaenids among the polyprotodont marsupials. He listed 49 anatomical characters and counted a vote of their bearing on the problem: 28 for thylacinid affinities, 8 for didelphid affinities, and 13 neutral. Counting complementary characters as one and omitting neutral characters, his final ballot was 27 for thylacinid relationships (18 important, 9 not) and 7 for didelphid affinities (2 important, 5 not).

Wood's general conclusion was that the borhyaenids were not only related to the Australian as opposed to the other American polyprotodonts (didelphids or didelphoids) but also that they were specifically related to *Thylacinus* as opposed to the

other Australian polyprotodonts, including *Dasyurus* and its allies. This was approximately Sinclair's opinion, which Wood made more explicit and backed with detailed stated evidence.

Cabrera (1927) pointed out that the opinions of Sinclair and of Wood were based on a small number of relatively late (Miocene) genera that did not adequately exemplify the whole complex of the borhyaenids. He accepted the evidence for Australian polyprotodont affinities but rejected the belief in specifically thylacinid affinities. He, therefore, recognized a superfamily Dasyuroidea with three families, Borhyaenidae, Dasyuridae, and Thylacinidae, believed to have evolved independently but more or less in parallel from a generalized dasyuroid ancestry.

Other opinions, based for the most part on these rather than on independent research, do not add significantly different theories. Thus Gregory (1910) said that Sinclair had proved thylacinid affinities. Scott (1913) also accepted this conclusion. Later (1937) he placed both borhyaenids and *Thylacinus* in the Dasyuridae, with some (but less definite) suggestion of special thylacine affinities among the dasyurids. Loomis (1914) accepted the general idea of Australian affinities but felt that reference to the Thylacinidae suggested too close a relationship and retained a family Borhyaenidae. He thus adumbrated Cabrera's theory, but gave no real evidence for it and did not clearly state it. Like Cabrera and unlike Sinclair and Wood, he was familiar with some of the pre-Santa Cruz borhyaenids, an important point in his trend away from the extreme suggested by Sinclair and later made concrete by Wood.

There are thus three authoritative theories now in the field:

- (1) The borhyaenids were derived from generalized polyprotodonts, didelphid by definition, independently of the dasyurids and thylacinids (Ameghino, Matthew).

- (2) The borhyaenids are thylacinids (Sinclair, Wood).

- (3) The borhyaenids are dasyuroids, but not specifically thylacinids, derived independently from the same generalized stock as the dasyurids and thylacinids (Cabrera).

My reasons for believing that the second of these theories is definitely incorrect and that the truth lies between the first and third, probably nearer the first, will be briefly summarized.

It has never been questioned that all the South American carnivorous marsupials (excluding those definitely didelphoid) are allied to each other. Whether classed as a suborder or order (as by Ameghino), a superfamily or family (as by Loomis, Cabrera, me, etc.), or as a subfamily or smaller group (as by Sinclair, Scott, Wood, etc.), no one seems to have questioned that they did have a common ancestry, nor is there any reason to question this now. The problem of affinities should, then, be approached from the point of view of the group as a whole, envisioning its diverse evolutionary trends as to potentialities and destiny and seeking an ancestry not for a few selected genera but for the whole known complex. The group includes not only the relatively uniform, normally specialized Santa Cruz forms, but also diverse more primitive and older genera and such extraordinarily aberrant and progressive forms as the younger *Thylacosmilus*.

If the borhyaenids are thylacinids, or closer to thylacinids than to either dasyurids or didelphids, there are only two possibilities:

(1) They were derived from a specifically thylacinid ancestry, or (2) the thylacinids were derived from them. The questions to be answered are: (1) did the borhyaenid ancestry have specifically thylacinid characters, and (2) was that ancestry structurally capable of giving rise to the thylacinids or did any known or inferable borhyaenid line definitely tend toward thylacinid basic (and not merely superficial) structure?

In this connection a first step is to take Wood's evidence, keenly observed and excellently digested but based on few genera, and to see whether it applies to the borhyaenid ancestry or to the borhyaenids as a whole and not only to these Miocene forms. The points that he considered important in this respect may be briefly reviewed from this broader point of view, facilitating reference by using the

numbers that he applied to the various characters.

2.—Dental formula. Didelphids: $\frac{5-? \ 1.3 \ 4}{4-3.1 \ 3.4}$
 Dasyurines: $\frac{4 \ 1 \ 3-2 \ 4}{3 \ 1 \ 3-2 \ 4}$ *Thylacinus*: $\frac{4.1.3.4}{3.1.3.4}$
 Borhyaenids: $\frac{4-0.1.3-2 \ 4}{3-0 \ 1.3-2.4}$ All these could be derived from $\frac{5.1 \ 3 \ 4}{4.1 \ 3 \ 4}$ The largest lower for-

mula known for borhyaenids did occur among fossil didelphids in which the upper formula is unknown. The incisive formula is unknown in the most primitive borhyaenids. The fact that I_3^s is the thylacine count has no bearing on special affinities because it is also the dasyure count, and under these circumstances there is no reason to suppose that it was not derived in the borhyaenids separately from a didelphoid count. Borhyaenid reduction set in early—already in the Casamayor there is a genus with I_3^s . This character is neutral, not an important thylacine resemblance.

4.—Protocone. Generally large in didelphids and small in dasyurids. In advanced borhyaenids it is often small, but in some primitive borhyaenids it is as large as in most didelphids. This character favors didelphoid, more than dasyurine or thylacinine, ancestry.

6-8.—Molar styles. In didelphids the parastyle is free and larger than the mesostyle, which is also free. In *Thylacinus* the parastyle is large and plastered on the paracone, the mesostyle absent. In dasyurines the parastyle usually forms a transverse ridge with the paracone and is smaller than the mesostyle when this is present. In Santa Cruz borhyaenids the condition is about as in *Thylacinus*, although the difference from *Sarcophilus* is not striking. In *Borhyaena* styler reduction is advanced and in *Thylacosmilus* it is complete. On the other hand, in primitive borhyaenids, notably *Patene*, the styles are less reduced than in dasyurids and are essentially didelphoid. This is undoubtedly primitive and must have occurred in the borhyaenid ancestry, which thus must have been more didelphid than dasyurine or thylacinine in this respect.

9.—Approximation of paracone and metacone. They are separated in didelphids and primitive dasyurines, approximated in *Sarcophilus*, *Thylacinus*, and advanced borhyaenids. But in primitive borhyaenids and hence in the borhyaenid ancestry they were separated. Hence the character is opposed to thylacine relationship, indifferent between didelphids and dasyurids.

10.— M^4 , a relatively large tooth in most didelphids and primitive dasyurids, reduced and somewhat shearing in many borhyaenids and in more advanced dasyurids. But here again the stages of reduction are to be found among the diverse borhyaenids and within this group the transformation was from an essen-

tially didelphoid to an essentially thylacine-like condition, as it was also among dasyuroids. The evidence opposes thylacine ancestry and is indifferent between didelphoid and dasyuroid.

13.—Metaconid. Present and large in most didelphoids and dasyurines, absent in *Thylacinus* and some borhyaenids. But other borhyaenids have a large metaconid and the reduction certainly occurred within that group. This character, too, opposes thylacine ancestry and is indifferent between didelphoids and dasyuroids.

17.—Palate. In didelphoids there is a ridge pierced or notched by two foramina. Dasyurines are similar but with a lower ridge and the foramina tend to be lost. In *Thylacinus* and advanced borhyaenids the ridge is represented only by thickening and the foramina are absent. This might favor thylacine relationships, but (a) the same condition is approached and practically reached by dasyurines, (b) this character is not known in any really primitive borhyaenid, and (c) the borhyaenid palate is otherwise very unlike that of any of the three other groups concerned.

19.—Nasals. Protracted in didelphoids, retracted in most borhyaenids and Australian forms. But in the borhyaenid *Arminihoringia* (an early form but specialized in dentition) the condition is intermediate and the character is not known in truly primitive borhyaenids (or in ancient didelphoids). The evidence is too imperfect to be adjudged other than neutral, or at best as possibly dasyuroid but not thylacine.

32, 34, 35, 36, 39.—Vertebrae. Without denying their importance, these may be lumped together because all are unknown in any pre-Santa Cruz or primitive borhyaenids and are also unknown in any Cretaceous or early Tertiary didelphoids, so that at best their evidence cannot be conclusive, however suggestive. In some striking respects the dasyurines show both didelphoid and thylacine characters in different genera, e.g., large or small neural processes on cervicals (35, 36), and these are manifestly adaptive characters dependent purely on size and power of the animals, not on affinities. As regards the free intercentrum of the atlas, borhyaenids show both conditions and nothing is shown except departure from a didelphoid-dasyuroid condition and the capacity to evolve a thylacine-like structure from this. The vertebral formula is not surely known in any borhyaenid and is doubtfully known in one species only. Even if the formula believed to be that of this species is correct, the loss of one rib, a common variation sometimes not even of generic value, would give the modern didelphid formula and in fact both occur among dasyurines. The known evidence of the vertebral column seems entirely inconclusive.

43, 45, 45.—Pelvis. These characters, also, are known for only a few borhyaenids, none ancient and none truly primitive, and the ancestral didelphoid repertory is not known. In two species of Santa Cruz borhyaenids the ilium is

known to be flattened and the acetabulum opens onto the obturator foramen, both dasyuroid characters and suggestive of such affinities, but not specifically thylacine. The probable absence of the epipubic bones in one species (and perhaps in others) of borhyaenids suggests their reduction in *Thylacinus*, which does, however, have them.

Thus of the 17 characters cited by Wood as important evidence of thylacine affinities, 3 seem to me really to favor didelphoid affinities, 7 seem to be almost completely neutral in the present state of knowledge, 3 are neutral as between didelphoid and dasyuroid but are opposed to specifically thylacine affinities, 2 favor dasyuroid affinities in general, one (retraction of nasals) may be placed in this category but could be considered neutral, and just one, probable absence of epipubic bones, might be taken as favoring thylacine affinities. Obviously this one character is a very slender basis for such a conclusion, and it is opposed, not reinforced, by the weight of the evidence. The question is not to be decided by a simple recount of the votes cast by Wood, any more than he thought the count decisive as such, but this is a convenient way to review the evidence.¹ This evidence seems to me strongly opposed to thylacine affinities, indeed conclusive against thylacine ancestry for the borhyaenids.

The other aspect of the problem, that borhyaenids might be ancestral to thylacines, is not so conclusively settled by these considerations. Some borhyaenids did develop characters like those of *Thylacinus* even though there is no good evidence that the borhyaenid ancestry as a whole had any of these characters. As Wood noted, no known borhyaenid could have this ancestral relationship. To prove the vague negative, that some unknown borhyaenid could not have been such an ancestor, is practically impossible, but neither is it urgently necessary to discount the unknown. Even a hypothetical borhyaenid combining all known *Thylacinus*-like characters of the group would

¹ Nor is the recount to be considered personally critical of Wood's conclusion, being based on evidence unknown when he wrote or not available to him. It is because his work was so careful that it is used as a basis for a revised opinion.

not make an acceptable ancestor for *Thylacinus*, because all known borhyaenids do have specializations that are absent in *Thylacinus*, as Sinclair and all later students have seen. To go back to a time when these were absent would be to go back to a pre-borhyaenid stage and to beg the question entirely.

The case for generally dasyuroid affinities, as in Cabrera's theory, is considerably better, but is almost on the same footing with the case for generally didelphoid affinities. Thus the ancestral borhyaenids probably had the nasals somewhat retracted, incisors somewhat reduced, and (with considerable uncertainty) may have had a slightly more carnassial type of molars than in modern opossums and a somewhat flattened ilium, with the acetabulum opening more on the oburator foramen than on the ischium. But, on equally strong evidence, they probably had molars distinctly more primitive, more didelphoid, than do living dasyuroids, and probably had the nasals widely expanded posteriorly, cutting off the frontals from the maxillas, more as in some didelphoids. In fact primitive dasyuroids and primitive didelphoids differ very little in structure and are hard to distinguish except geographically. If one postulates a dasyuroid primitive enough to be ancestral to the borhyaenid group as a whole, it is, practically speaking, indistinguishable from a didelphoid, for the dasyuroids are distinguished from didelphoids only by slight advances not known to have occurred in the borhyaenid ancestry. Cabrera's idea of independent borhyaenid and dasyurid derivation from a common ancestry seems to me entirely sound, but I do not think that ancestry can have been clearly distinct from the ancient (Cretaceous) didelphoids. As for *Thylacinus*, there seems to be abundant, conclusive evidence that it is merely a specialized dasyurid.

A common ancestry combining the primitive dasyuroid with the primitive didelphoid characters would be more didelphoid, that being the more conservative of the two lines. Such an ancestry for the Borhyaenidae is the only one well sup-

ported by the evidence now in hand. Given such a common ancestry, with the same genetic constitution at the beginning of divergence and with the same approximate repertory of mutational possibilities, and given similar environments, it seems not surprising but indeed inevitable that specialized animals evolved independently by adaptation for essentially identical ways of life would resemble each other as much as do, for instance, *Borhyaena* and *Thylacinus*. If they had any more immediate common ancestry, they would be expected to resemble each other still more than they do, and in characters less visibly adaptive.¹

Where the common ancestor of didelphids, dasyurids, and borhyaenids lived is a different question and one not to be discussed here. The conclusion that the common ancestry to be sought is, on present evidence, that of all three of these groups, and not that of two, excluding the other, does, however, put this question on quite a different footing. For instance it removes any particular reason for postulating a connection directly between Australia and South America, although in itself not disproving such a postulate.

As in many other cases, while I agree with all recent workers in rejecting certain of Ameghino's hypotheses regarding these animals, it appears that his more important conclusion regarding borhyaenid-dasyure affinities has been too lightly regarded and that this was essentially correct. The conclusion reached in this paper is also more or less consonant with those of both Matthew and Cabrera, or at least not vitally contradictory to either, but is nearer that of Matthew.

¹ Scott (1937) says that "to maintain that the Australian genera, on the one hand, and the South American genera, on the other, were independently derived from didelphid ancestors, involves such a degree of convergence as has never been admitted for any other group and for which there is no warrant." In the first place, I feel that he over-emphasizes the resemblance, which is great but hardly great enough for such emphatic statement. In the second place, the common ancestry was not didelphid in the strict modern sense but doubtless lacked some special characters of modern opossums and had some preserved in dasyurids and not in didelphids. And in the third place, this is not convergence (like, for instance, the far less striking horse-litoptern resemblance) but parallelism, which is on quite a different basis of probability.

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SOME CARIB INDIAN MAMMAL NAMES

BY GEORGE GAYLORD SIMPSON

INTRODUCTION

In an earlier paper on Mongolian mammal names¹ I have emphasized the value and importance of compiling vernacular lists of mammal names. Most of what was said there applies with equal force to names used by Carib Indians in South America, the one exception being that no Carib dialect has any native written literature. The Carib languages are still the speech of the country over enormous areas in Venezuela, the Guianas, and Brazil, including regions where it is difficult or impossible to find any local inhabitant who speaks a European language. Their importance to the traveler and collector is thus obvious. It is also noteworthy that many explorers give the Carib names in their publications and that knowledge of these is essential to the technical reader. If the explorer was not a mammalogist or did not see the animal himself, the Carib name is more likely to be correct than is the European or the scientific name given in such publications. As is true also of Mongolian, Carib dialects have provided some of our popular (e.g., manatee) and some of our scientific (e.g., *Alouatta*) names for mammals, although it is true that a very different group of South American languages, Tupi-Guaraní, is more important in these respects.²

The following lists were based, in the first place, on a vocabulary of the Kamarakoto dialect and another of the Taurepán dialect that I recorded in southern Venezuela early in 1939 while attached to the

Comisión Exploradora de la Gran Sabana of the Ministerio de Fomento, a department of the Venezuelan Government. In this connection I am much indebted to the minister, Dr. Manuel R. Egaña, and to the organizers of the expedition and my companions on it, Drs. Victor M. López, Santiago E. Aguerrevere, Carlos Delgado O., and Carlos Freeman. My presence in Venezuela was made possible by the generosity of Mr. H. S. Scarritt. The accurate equation of Indian with scientific names was made possible in many cases by the collection of mammals made on the same occasion by my wife, Dr. Anne Roe. Technical lists of the mammals of this general region have been given by her (Roe, 1939) and by Tate (1939). The species named below are those of the Arekuna region. Animals known to the other Caribs are mostly the same species, or other races of them.

Knowledge of these two dialects has been supplemented by reference to many standard works, of which those of Koch-Grünberg (especially for Taurepán), Williams (for Makuchi), de Goeje (for Kalifia and compiled comparative Carib vocabularies), and Adam (compiled comparative vocabulary) are most important. I have cited an authority for each word not recorded by me. In a few cases these are secondary authorities (especially Adam and de Goeje) since their compilations make it unnecessary for present purposes to refer to the very scattered literature on each separate dialect. In most cases I have also given the Venezuelan Spanish names, since these often differ markedly from the Spanish of other regions.

¹ 1938, Amer. Mus. Novitates, No. 980.

² See Simpson (1941), a summary of English vernacular names for South American mammals, written after the present paper but published first.

DISTRIBUTION OF DIALECTS

Carib languages and dialects have been spoken from Cuba and Central America to southern Brazil and from almost the extreme eastern end of South America to the foot of the Andes. They were not spoken in the Andes, except for the Motilones in the Perijá mountains, or west or south of Brazil. The outlying dialects are now mostly extinct or survive in isolated communities in regions predominantly of some other speech. These therefore have little interest from the present point of view. The main region where Carib languages are still the predominant or the only local idioms includes Venezuela south and east of the Orinoco (Venezuelan Guiana or, more properly, Guayana), most of British, Dutch, and French Guianas (especially their southwestern parts), and much of the contiguous parts of Brazil north of the Amazon. This constitutes what is probably the largest single mass of any one stock of Indians still retaining their own speech, organization, and customs that survives anywhere in the world.

Although the Caribs of this region all speak recognizably related tongues, just as the Portuguese, Spanish, French, Italians, and Rumanians all speak Romance languages, these are differentiated into several distinct languages and many local dialects. Kamarakoto, spoken around Auyán-teptú, a great mountain northwest of and somewhat similar to Roroimá,¹ and Taurepán, spoken near to and generally westward of Roroimá, are dialects of the Arekuna language (much as British and American are, properly, two dialects of the English language although the descent is not analogous). The particular interest of Arekuna is that it is, at least in some respects, archaic and that it is spoken almost in the middle of the great central mass of Carib distribution. Zoologically, also, the Arekuna area is of great interest,

occurring in a transitional zone within the Neotropical realm and still relatively unaffected by human interference. Some collecting has already been done there, but the fauna is not yet well known and further field work is needed.

It would be confusing to attempt to trace names through every known dialect, even in this central region, so that only four of major importance will regularly be cited (when the words are on record) and others mentioned only if some name in them happens to have special interest. Aside from Kamarakoto and Taurepán, the languages to be cited regularly are Makuchi, south and east of the Arekuna-speaking area, in northern Brazil and southwestern British Guiana, and Kaliña, spoken mostly in Dutch Guiana, a dialect of "Carib" in the strictest sense (not the broader sense used here, much as a "Roman" language might contrast with a "Romance" language). Other languages incidentally mentioned are Akawai, spoken generally in western British Guiana and into Venezuela, northeast and east of Arekuna; Galibi, a dialect very near Kaliña, spoken in the coastal region between Cayenne and Paramaribo; Trio, spoken in southern Dutch Guiana; Vakairi, spoken on the Xingu in Brazil; and Chayma and Cumanagoto, formerly spoken in the northeastern coastal region of Venezuela. Arawak is, of course, a whole family of languages like Carib and the several Arawak names cited here (mostly from de Goeje) are in the dialect of Dutch Guiana as far as that differs from the rather uniform language of the main bodies of Guiana Arawaks. Tupi-Guaraní designates another great family of languages spoken along the Amazon and south to the Río de la Plata. The "Lingoa geral" is a more or less standardized form of Tupi, proper, widespread as a means of communication among the diverse natives of Brazil and it is this form that is cited.

¹ Or "Rorsima." "Roroimá" more nearly represents the Indian pronunciation and therefore seems to me more nearly correct.

TRANSCRIPTION

The Carib phonetic system is very unlike that of any European language and also varies greatly from one dialect to another, so that any exact representation of the pronunciation is impossible without lengthy discussion and the use of many specially cast typographic symbols. Only a rough approximation, sufficiently close generally to produce a pronunciation recognizable by the Indians, is here attempted. The following remarks are based chiefly on Kamarakoto, because I know it best, but extension to other dialects will not produce unrecognizable distortion. In citing names from other authors I have transferred them into my system of transcription, as nearly as may be, instead of attempting to explain the different system used by each author.

VOWELS.—*a*, *e*, *i*, *o*, and *u* will be recognized if pronounced as in Spanish or Italian, i.e., given the so-called continental values.

There is a whole system of intermediate (central) vowels in Carib that cannot be correctly represented with our ordinary letters. For typographic simplicity I have represented the most essential of them by *ā*, *ē*, *ō*, and *ū*. *ā* is to be pronounced approximately like short *e* in English, i.e., about as in "met." This is quite different from the sound represented by *e* and is sharply distinguished by the Indians themselves. In many cases however, authors have not distinguished them in transcribing Indian words and in names cited from other authors the sounds given as *e* doubtless include some that are really *ā*. *ē* is near the so-called neutral vowel of English, about like the last *e* in "pavement" (as it is really pronounced in rapid speech, not with an affectedly clear pronunciation) and almost exactly like the French sound in "de" or "le." It is very unlike *ā* or *e*, being much more like *ō*, and the best authorities (such as de Goeje, Williams, Koch-Grünberg) usually distinguish it, but here again some writers, especially those whose native language (particularly Spanish) includes no similar sound, tend to write *e* and in citing such

authors there is no way of telling when this sound really occurs. *ō* and *ū* are not exactly like the German sounds written in the same way or like French *oe* and *u*, respectively, but are near enough to make those pronunciations recognizable. In some dialects *ō* is barely or not distinguishable from *ē*. Most Spanish-speaking authors and some others (notably Williams although he is otherwise an excellent authority) do not distinguish *ō* from *o*, or sometimes from *ē* or even *e*, and *ū* from *u*. German authors, familiar with analogous sounds, do usually make the distinction, notably Koch-Grünberg.

Two successive vowels of which the second is *-i* or *-u* are to be pronounced as falling diphthongs. For instance, *ai* is pronounced as in Spanish or as in the English word "aisle."

CONSONANTS.—In general the usual English pronunciation is sufficiently close. *b* and *d* tend to be soft (nearly *v* and *th* as in "that"), but the hard (fully closed) pronunciation is a sufficiently safe general rule. *g* is always hard, as in "get," never as in "gem." *sh* is pronounced as in "ship," *ch* as in "chip," and *j* as in "judge." *w* is pronounced as in English, not as in German. *r* and *l* are interchangeable in Carib and no dialect really distinguishes the two. The correct pronunciation is impossible to an English-speaking person without long practice. Ordinary English (sounded) *r* and *l* will usually be recognizable. The flapped or single-trill Spanish *r*, if the reader has acquired it, is much closer, but the fully trilled Spanish *rr* is bad and French or German guttural *r* still worse. *n* is usually as in English words such as "no" or "on," but almost invariably at the end of words and before *k*, *g*, and *w* it takes on something or much of the sound of *ng* as in "sing." The sound here represented by ' is another that does not consciously occur in European languages. It is formed by suddenly bringing the tongue in contact with the palate after a short vowel sound. It can be approximated by pronouncing a *t* after *i* and a *k* after other vowels, and has often been so written by

travelers, or as *d* or *g*. This will be recognizable but is incorrect in that *t* and *k* derive most of their sound from the release of breath when the tongue is removed from the palate, whereas in the Indian sound ' this release is nearly or quite inaudible. *th* is as in English "thin" and *zh* like *z* in "azure." Both sounds are rare and are usually variants of *y*. *y* in general is as in English or Spanish, but it is a peculiarly fluid and protean sound in Carib, even within one dialect, varying from a sound almost *d* to one almost *zh*. It will, however, usually be understood if constantly pronounced as in "yet."

ACCENT.—In Kamarakoto and Taurepán the last syllable is almost always short but carries the stress accent, and this is

probably true of most Carib dialects. The penultimate vowel is usually rather long and may be very long, as preceding vowels may also (but very rarely) be. When such vowels are very long, the unstressed length has much the effect on our ears of an accented syllable, our accent being usually a combination of stress and length while these are independent in Carib. In my own transcriptions and when I have been able to recognize them surely in those of others, I represent these superlong vowels by placing a colon after them. Accent will usually be near enough for recognition if these marked long vowels are accented when they occur and the last syllable is accented when they do not.

MAMMALIA

Animal in general, almost invariably referring to mammals—Kamarakoto *woto*. Taurepán *woto*. Makuchi (Williams) *kamo*. These words usually mean an animal to be hunted and Williams notes the special applicability of *kamo* to deer, an example of the curiously world-wide

transfer between the name of a favorite game animal and that of animals in general. The words are also used secondarily to mean "meat," which is more specifically *woto-pun* in Kamarakoto. The Makuchi word is not typically Carib and may well be borrowed for Tupi.

MARSUPIALIA

Opossum, Venezuelan Spanish "rabil-pelado," *Didelphis marsupialis* and *Metachirus nudicaudatus*, and probably also *Marmosa* spp.—Kamarakoto *abare* (open *b*, nearly *v*). Taurepán *aware*. Makuchi (Schomburgk) *yawari-kusinai*, identified as *Philander*. Kalina (de Goeje) *awari*. The Guiana Arawak name, *yawali* (de Goeje), is obviously cognate.

Yapok, water opossum, Venezuelan Spanish "perrito de agua" (but this may also be applied to small otters), *Chironectes minimus*—Kamarakoto *abarepoka*, *maparwa*. These were said to be two names for the same animal, the description of which strongly suggests *Chironectes* as does

the inclusion in *abarepoka* of the root for "opossum," although the equation was not definitely established. There is in the Indian mind as well as in those of most other residents of northern South America confusion between the yapok, various otters, and some other water animals. Makuchi *marparwa* is given by Schomburgk as meaning the larger species of otter, while Williams defines it as a kind of frog. Taurepán *aparowa* is cognate, but it is uncertain whether it means *Chironectes*, an otter, or both. Taurepán *awa:lipoka* is given by Koch-Grünberg as a name for an otter, but obviously equals Kamarakoto *abarepoka*.

CHIROPTERA

Bat, Spanish "murciélago," all genera and species—Taurepán *maribe'* (given by Koch-Grünberg as *mali:pa'*¹). Makuchi (Williams) *mara:pa*. Kaliña (de Goeje) *leri*. Bakairi (Adam) *meri*. These all contain one root, *leri* = *meri* = *mari* = *mara*, but it undergoes marked transforma-

tions. No Caribs seem to distinguish different kinds of bats except adjectivally as "large," "small," etc. The Kamarakoto word is remembered as *maripai'*, but the written record was mislaid and this is not reliable.

PRIMATES

Monkey, Spanish "mono," primarily *Cebus apella* but probably including some other forms—Kamarakoto *ibarga*. Taurepán *ibarga*, *iwarka*. My Kamarakoto and Taurepán informants distinguished only two sorts of monkeys, *ibarga*, including *Cebus* and probably any other of the here rare smaller monkeys, and *arauta*, the howler. Williams gives the following list for the Makuchis (the identifications are his):

"*Ateles paniscus*"—*kwa:të*.

"*Cebus* sp."—*karima*.

"*Cebus capucinus*?"—*iwaru:ka* (despite the shift of vowel lengths = *ibarga*).

"*Pithecia leucocephala*"—*thari:ki* (this Makuchi *th* = *y* in most other dialects).

"*Pithecia satanas*"—*kuchi:wë*.

"Sackawinki"—*ita:ru*.

Unidentified—*kari*.

De Goeje gives the following partly cognate list for Kaliña (identifications de Goeje's):

"*Ateles* sp."—*kwa:ta* (= Makuchi *kwa:të*).

"*Cebus* spp."—*me:ku* (a form of a widespread Carib root, *miko*, etc., for small monkeys).

"*Cebus*, small species"—*akalima* (= Makuchi *karima*).

"*Pithecia leucocephala*"—*aliki* (= Makuchi *thari:ki*).

"*Pithecia satanas*?"—not given in Kaliña, *kusi:ri* in the allied languages Trio and Oyana (probably = Makuchi *kuchi:wë*).

"*Pithecia chiropotes*"—*kesyu*.

"*Nyctipithecus*"—*kubara*.

"*Hapale jacchus*"—*kusi:ri* (same as Trio *kusi:ri* although differently identified).

Obviously these two tribes both know and distinguish more monkeys than do the Arekunas. In their area we saw only *Cebus* and *Alouatta* and such other genera as may occur are apparently very rare.

Howling monkey, Venezuelan Spanish "araguato," *Alouatta senicula*—Kamarakoto *arauta*. Taurepán *arauta*. Makuchi (Williams) *arauta*. Kaliña (de Goeje) *alwata*. Cumanagoto (de Goeje) *arawata*. The scientific name *Alouatta*, which has priority over the frequently used *Mycetes*, is derived from a French spelling of the Carib word in some dialect in which it was pronounced as in Kaliña. The Venezuelan Spanish name was also derived from the Carib root, but in the form seen in Cumanagoto.

XENARTHRA

Three-toed sloth, Spanish "pereza," *Bradypus tridactylus*—Kamarakoto *kwaran*. Taurepán *kwaran*, *kuwaran*. Makuchi (Williams) *kuwaran*. Kaliña (de Goeje) *kupirisi*. Williams defines the Makuchi word as *Choloepus*, but Schomburgk gave it for *Bradypus* and was, I think, probably correct. There is great confusion in the

European understanding of the native names for this and the following animal, and among the Carib tribes themselves there is little uniformity. I am sure of the Kamarakoto usages, because they were checked against specimens. No tribe fails to distinguish the two genera, although civilized residents seldom separate them.

Two-toed sloth, Spanish "pereza," *Choloepus didactylus*—Kamarakoto *nupi*. Taurepán *nupi*. Makuchi (Williams) *te-nupi*. Kaliña (de Goeje) *aiipaula*. Williams

¹ Koch-Grünberg's Taurepán is that spoken south of the Brazilian border and differs slightly but appreciably from the purer Taurepán spoken north of the border around Santa Elena where I recorded my Taurepán vocabulary.

identifies *tenupi* simply as "sloth" and gives a Makuchi word, *waiwa*, for a third kind of sloth, but this must, I think, be an error, possibly a confusion with *woiwa*, an anteater, see below.

Giant anteater, Venezuelan Spanish "oso palmero," *Myrmecophaga tridactyla*—Kamarakoto *waremā*. Taurepán *waremā*. Makuchi (Williams) *tamanowa*. Kaliña (de Goeje) *tamano:a*. Here again there is great confusion between names for the two common anteaters and I can guarantee only the Kamarakoto and Taurepán usages. Words cognate with *waremā* are often recorded as meaning *Tamandua*, not *Myrmecophaga*, and I do not know whether this is a real difference in Indian usage or simply error on the part of the recorders. Similarly words of the general form *tamanua* are sometimes given as applying to *Tamandua* and of course that scientific name is derived from this native root, which is perhaps of Carib origin although it also occurs in Tupi, Arawak, etc., and is practically an international word among South American Indians. It is curious that most authors give the variants of *tamanua* as meaning *Myrmecophaga*, not *Tamandua*, in Carib languages. In Tupi this word applies to both genera. The scientific limitation of the name to *Tamandua* does not follow native usage.

Lesser anteater, local Spanish "oso hormiguero," *Tamandua tetradactyla*—Kamarakoto *woiwo*. Taurepán *woiwo*. Makuchi (Williams) *waiwa*. I could not determine whether the Arekunas know *Cyclopes* or whether they distinguish it from *Tamandua*. De Goeje gives *walili* as Kaliña for *Cyclopes* ("*Myrmecophaga didac-*

tyla") but queries it, and apparently cognate words in other dialects are usually defined as *Myrmecophaga*, *Tamandua*, or both. This may even be cognate with Arekuna *waremā* (with a root *ware* which is a normal Carib transformation of *wali*).

Nine-banded armadillo, Venezuelan Spanish "cachicamo," *Dasypus novemcinctus*—Kamarakoto *atsi:gamo*. Taurepán *kai'kan*. Makuchi (Williams) *kaikan*. In the recorded vocabularies of other dialects the identifications are so vague or confused that they have little or no value. I have not been able to trace the exact distribution and history of the two very different roots appearing in the distinct Arekuna dialects. The Kamarakoto word appears to be an interesting survival of an otherwise nearly lost Indian word from which the Venezuelan "cachicamo" is derived.

Cabassu, *Cabassous* probably *unicinctus*—Kamarakoto *merun*. Taurepán *mu'ru'*. Makuchi (Schomburgk) *mu:ru*. Kaliña (de Goeje) *kapasi*. Variants of *kapasi* (*kabasi*, *kapahu*, *kapasu*, etc.) are the most widespread names for this animal in Carib languages, and it seems probable that the French vernacular word on which the prior scientific name was based is derived from a form of this Carib word. At least this is far more likely than Azara's guess that it was a corruption of the Guaraní "*caaigouazou*," "large forest-dweller."

Giant armadillo, Venezuelan Spanish "cuspa," *Priodontes gigas*¹—Kamarakoto *mauraima*. Taurepán *mauraimē*. Makuchi (Schomburgk) *maouraima*. Kaliña (de Goeje) *manulena*.

RODENTIA²

Squirrel, Spanish "ardilla," *Sciurus* (*Guerlinguetus*) spp. (those seen were all of the *S. aestuans* group).—Kamarakoto *kari*. Taurepán *kari*. Kaliña (de Goeje) *ksiipulu*. Trio (de Goeje) *me:ri*. This word is seldom given in vocabularies so that I cannot account for the three decidedly different roots in the languages here cited.

Capybara, Venezuelan Spanish "chi-

güire," *Hydrochoerus hydrochoerus*—Kamarakoto *kapi:ba*. Taurepán *paruena*. Makuchi (Williams) *parawi*. Kaliña (de

¹ Pittier and Tate omit this species from their Venezuelan check-list, but it certainly occurs in southern Venezuela.

² Contrary to some statements, it seems certain that lagomorphs occur in Venezuela south of the Orinoco, but perhaps not among the tribes here chiefly considered and I find no Carib word for them. They are unknown to any Arekunas of my acquaintance.

Goeje) *kapia*. Most Carib dialects have variants of the root seen in Kamarakoto and Kaliña and these, in turn, are related to (probably derived from) the "Lingoa geral" (Tupi) *kapiwara* from which have come our English vernacular name and one of the several Spanish names for this animal.

Paca, Venezuelan Spanish "lapa," *Cuniculus paca*—Kamarakoto *urana*. Taurepán *ura:na*. Kaliña (de Goeje) *pak* (= *pa'*?). The root seen in *urana* occurs (with great variations) in most Carib languages. The root *paka*, which has been borrowed by the Kaliñas, as well as in English and in the technical specific name, is "Lingoa geral" (Tupi). The root *lapa* is Arawak (also used in the English of British Guiana as "labba").

Aguti, Venezuelan Spanish "acure," *Dasyprocta cayanus*—Kamarakoto *akuri*. Taurepán *akuri*. Makuchi (Williams) *aku:ri*. Kaliña (de Goeje) *aku:li*. This word is international among the South American Indians, occurring in practically all Carib dialects as well as in Arawak, Tupi-Guaraní, etc. The Venezuelan Spanish word is from some Carib dialect allied to those cited and the forms with *-t*, as in English, are probably from Tupi, *akuti*, or a closely allied form.

Guinea-pig, cavy, Venezuelan Spanish "acurite," *Cavia guianae* and *porcellus*—Taurepán *atu*.¹ This animal apparently has a very limited Venezuelan distribution but it is common in the Taurepán country near the Brazilian border.

Spiny rat, Venezuelan Spanish (in the llanos) "casiragua," *Proechimys cayannensis*—Kamarakoto *urare*. Taurepán *urare'*. Makuchi (Hübner in Koch-Grünberg) *urare*. The last word is defined as "*Hesperomys*," which I cannot flatly contradict but which is most improbable since the

closely allied Taurepanes, like the Kamarakotos, certainly use the same word only for the spiny rats.

Rats and mice in general, Spanish "ratas," "ratones," many genera and species of Cricetidae—Kamarakoto *mōmbē*. Taurepán *mōmbē*. Kaliña (de Goeje) *mombo*. This is the general word used to cover almost all rat- or mouse-like animals, as the English vernacular words are.

Unidentified rats or mice (cricetids?); words given as applying to rat-like animals and probably distinctive of certain limited groups, but not defined by the information available:

Kamarakoto *simuru* ("large rat with a long tail").

Taurepán *pulūya* ("large rat"), *sarikau* ("small rat with large ears and long hair"), (Koch-Grünberg) *waimu'pē* ("rat"—this may be equivalent to *mōmbē* and be a Makuchism among the southern Taurepanes). Makuchi (Williams) *waimu* (perhaps a general word, Makuchi equivalent of *mōmbē*), (Williams) *pureya*.

Including *mōmbē* and *urare*, there are six different roots for "rat" or some particular kind of rat in these three languages. All specimens of this sort collected by us were either *urare* or *mōmbē*. It remains for future collectors to fix the meanings of *simuru*, *pulūya* = *pureya*, *sarikau*, and *waimu'pē* = *waimu*.

Porcupine, Spanish "puerco espín," *Coendu prehensilis*—Taurepán (Koch-Grünberg) *alu*. Kaliña (de Goeje) *mulūu*. This animal seems to be very rare in this general region. My informants did not know it and the name is lacking in Williams' large Makuchi vocabulary and in most other Carib vocabularies. Koch-Grünberg obtained the Taurepán word, but notes that the animal is rare. None has been found in this area by collectors.

¹ Koch-Grünberg defines *atu* as a "rat," but he is mistaken.

CARNIVORA

Jaguar, Venezuelan Spanish "tigre," *Felis onca*—Kamarakoto *kaigutsa*. Taupán *kaikusā*. Makuchi (Williams) *kaiku-chi*. Kaliña (de Goeje) *kaiku:si*, *kaiku:shi*. Most tribes have an elaborate nomenclature for various kinds of jaguars according to size, color, or fancied resemblance to other animals. Some of these are purely mythical and the rest simply variants of the local race of jaguar. This specialized nomenclature has some ethnological but practically no zoological interest and no attempt is made to give it here. As far as I could judge, it did not suggest real knowledge of more than one natural subspecies or race in each area.

Puma, Venezuelan Spanish "león," *Felis concolor*—Kamarakoto *kutsaribara*. Taupán *kusariwara*. Makuchi (Schomburgk) *soasorana*. Kaliña (de Goeje) *kusaliwala*. In all these and some other Indian languages the puma appears to be named for its supposed resemblance to a deer (*kutsari* in Kamarakoto, see below). The Makuchi word for "puma" curiously contains the Tupi, not the Makuchi, word for this deer. Bates ("Naturalist on the . . . Amazons") supposes the naming of the puma for a deer to arise from the two animals having the same color and Williams adds that he has actually mistaken a puma for a deer. Despite this testimony and without being able to adduce any direct evidence for my suspicion, I do suspect that the original explanation, perhaps now forgotten by the Indians themselves, was different and had to do with their magical beliefs.

Ocelot, Venezuelan Spanish "cunavara, cunaguaro" "tigrillo," *Felis pardalis*—Kamarakoto *marakada*. Taupán *marakada*. Kaliña (de Goeje) *maraka:ya*. These words are all related to and perhaps derived from the Tupi-Guaraní word *mbarakadya*, *marakaya*, etc. They possibly include other small cats besides the ocelot.

Fox, savanna fox, Spanish "zorro," *Cerdocyon thous*—Kamarakoto *maikan*. Taupán *maikan*. Makuchi (Williams) *maikan*.

Bush dog, Venezuelan Spanish "perro de

monte," "perro grullero," *Ichtyon venaticus*¹—Kamarakoto *yai*' (with a very close *y* almost like English *th*). Taupán *yai*' (similar *y*).

Domestic dog, Spanish "perro," *Canis familiaris*—Kamarakoto *pero*. Taupán *arimōraga*. Makuchi (Williams) *arimara:ka*. Kaliña (de Goeje) *pero*. The Kamarakoto and Kaliña names are, of course, derived from the Spanish but the other two are true Carib and the dog was known to some Caribs before Columbus. Carib names for other domestic animals are all either onomatopoeic or derived from European languages. Many South American Indians call dogs by a name identical with or closely related to that for the jaguar, but these Caribs do not.

Coati, Venezuelan Spanish "zorro guacho," *Nasua* sp.—Kamarakoto *ibarwana*. Taupán *iwarwana*. It is not quite certain that this is always the coati, strictly speaking, but it is the only word the Kamarakotos know for animals of this sort and probably includes any species of *Nasua sens. lat.* and perhaps other procyonids, if any occur in their region.

On the other hand, the Taupanes not only have this word but at least two others: *araiwa*', "something like a fox, with a black head, and climbs trees," and *koazhi*, "like an *araiwa*' but does not climb trees." I could not equate these with actual specimens. The second is a form of the widespread root preserved in our English "coati," a root derived from or spread through the Tupi language. The Arawak root *kibihi* (and variants) is also used for the coati in some Carib languages (e.g., Akawai).

Otter, Venezuelan Spanish "perro de agua," "nutria," *Lutra*, probably mostly *L. brasiliensis*—Kamarakoto *saro*. Taupán *saro*'. Makuchi (Williams) *tura:ra*, (White in Beebe's "Tropical Wild Life in British Guiana") *saro*. Kaliña (de Goeje) *awalibuya*. There is little or no doubt that the *saro* is *Lutra brasiliensis*, but the

¹ Pittier and Tate note that this dog probably occurs in Venezuela. It is now known definitely to occur in that country, in Venezuelan Guayana north of the Brazilian border. The only recorded specimen was taken alive in the Tirika valley by our companions on this expedition.

records of native nomenclature of the otters are otherwise very confusing. See *Chironectes*, above. Besides *saro*, Koch-Grünberg gives four other Taurepán names for otters: *asa:len*, *kara:saiyana*, *kali'nakon*, and *jili:ligon* (with variants of

each). My Taurepán informants did not know any of these words, and I suspect that they are mythical animals or color variants and not natural forms distinct from the *saro*.

SIRENIA

Manatee, Spanish "manatí," *Trichechus inunguis*—Kaliña (de Goeje) *yala:wa*, *kayumoru*. Makuchi (Appun) *koimuru*. Chayma (de Goeje) *kuyumuri*. The Arawak word is also *kuyumulu*, *kuyumoru*, etc. The Kamarakotos and Taurepanes apparently do not know the animal.

There has been much discussion of the derivation of the word "manatee" (beyond the fact that it is the Spanish "manatí"). West African origin has been suggested but now generally discarded in favor of West Indian origin, probably Carib. This is given in all the dictionaries that I have consulted and apparently is accepted by all zoologists. The usual etymology is to derive it from a Carib word *manatui*, or a similar form, and this is occasionally (e.g., Century Dictionary) said to mean "big beaver."¹

Some of the oldest vocabularies of West Indian Carib do give *manatui* (or an analogous spelling) as the name of this animal. This is further evidence that the

early travelers believed this to be a Carib word, but it is not proof that it really was such. As far as I can learn, in surviving dialects on which there is reliable information the manatee is never designated by any word remotely resembling *manatui* or *manati*. There is, however, an indubitable Carib word that is obviously this, or closely related to this: Arekuna *manati*, Makuchi (Williams) *manatē*, Galibi (Adam) *manate*, Akawai (Adam) *manadu*, etc. This word means, not "manatee," but "(a woman's) breast." Since the most striking character of the manatee to most observers, primitive and otherwise, is the human appearance of the mammae, it is a reasonable conclusion that this is really the origin of the name. It is not known, and probably is not now knowable, whether the Island Caribs themselves extended the word and used it as a name for the animal or whether they used it only descriptively and it was mistaken by Europeans for a name.

PERISSODACTYLA

Tapir, Venezuelan Spanish "danta," *Tapirus terrestris*—Kamarakoto *maikuri*. Taurepán, *waira*. Makuchi (Williams) *waira*. Kaliña (de Goeje) *maipura*, *maipuri*. Both these roots are widespread in

Carib. In some dialects *waira* is liable to confusion with a word of indelicate meaning and this has perhaps influenced the use of the other word for "tapir."

ARTIODACTYLA

Savanna deer, Spanish "venado," *Odocoileus* probably *gymnotis*—Kamarakoto *waikin*. Taurepán *waikin*. Makuchi (Williams) *waikin*.

Red brocket, *Mazama americana*—

Kamarakoto *kutsari*. Taurepán, *kusa:ri*, *usa:ri*. Makuchi (Williams) *usa:ri*. Kaliña (de Goeje, questionably given as "*Cervus nemorivagus*") *kusali*.

Gray brocket, wood deer, *Mazama nemorivaga*—Taurepán *kariyaukē*. Makuchi (Williams) *kariyauku*. Kaliña (de Goeje) *kariaku*. My Kamarakoto informants

¹ Although it is not explained why the Caribs should describe a familiar animal in terms of one they probably never saw.

did not name this animal, although it occurs in their region and is doubtless known to some of them.

Collared peccary, Venezuelan Spanish "chácharo," *Tayassu tajacu*—Kamarakoto *pakira*. Taurepán *pakira*. Makuchi (Williams) *paraka*. Kaliña (de Goeje) *pakira*. Cumanagoto (Adam) *vakira*. This root, which also occurs as a loan in some Tupi dialects, has given us our word "peccary." It is peculiar that it has also given rise to the colloquial Spanish "báquiro," through Cumanagoto or an allied Carib dialect, but that this name was transposed by the colonists from this animal, to which it belongs, to the other peccary which has a different Carib name. The

Makuchi form is an unusual example of metathesis, *paraka* for *pakara*.

White-lipped peccary, Venezuelan Spanish "báquiro," *Tayassu pecari*—Kamarakoto *po-inga*, *poyinga*. Taurepán *po-inga*, *pyinge*. Makuchi (Williams) *po-inga*. Kaliña (de Goeje) *pi'ndya* (final vowel rounded). Koch-Grünberg has a word *tekenoma* (pronounced *tokōnome* by my Taurepán informant and *tauka:namo* in Kamarakoto) which he lists as if it were a separate, third species of peccary, but its real meaning is "a particularly bad or dangerous wild animal, especially a large and ferocious *po-inga*," as explained to me by Indians of both these tribes.

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THE EOGENE OF PATAGONIA

By GEORGE GAYLORD SIMPSON

In previous papers (Simpson 1933, 1935a, 1935b) I have discussed the general stratigraphy and nomenclature of the early to middle Tertiary terrestrial formations of Patagonia and the local stratigraphy of the interesting and crucial Gaiman region, on the Chubut River. Since those publications, a semi-official stratigraphic no-

menclator has been issued by Argentine government geologists and several important papers on the Gaiman region have appeared. These authors invite comment, and a review of the present status of the usages and problems involved may be of considerable interest to northern stratigraphers and paleontologists.

STRATIGRAPHIC TAXONOMY

Fossa-Mancini, Feruglio, and Jussen de Campana (1938) have recently issued a classification and nomenclature of the Patagonian sedimentary rocks. This is based on the collaboration of various local workers and is intended to help standardize usage and to serve as a basis for work in the Y. P. F. (Yacimientos Petroliferos Fiscales, the government organization for the discovery and development of oil fields). It is thus highly authoritative and semi-official in character. Only the parts concerning the mammal-bearing formations between the marine Salamanca (latest Cretaceous or early Paleocene) and the marine Patagonian (late Oligocene or early Miocene) will be discussed here. The early history of the classification has been traced in detail by Frenguelli (1930) and more briefly by me (1933) and need not now be reviewed. The accompanying diagram shows the development of this subject in five pertinent papers appearing since Frenguelli's review of 1930.

Although none of the names used by him were strictly new, the modern nomenclature of these strata essentially dates from Frenguelli's paper of 1930 which is, as I have elsewhere acknowledged, an outstanding work to which all Patagonian stratigraphers are greatly indebted. I modified

it, mainly on the basis of new studies and discoveries, in these ways:

(1) By recognizing (in 1935) that the uppermost terrestrial beds near Trelew and Gaiman are decidedly different from those south of Colhué-Huapi in facies and perhaps later in age. Rejected by Frenguelli, not considered by the Y. P. F., strengthened and made more definite by Bordas.

(2) By recognizing that Ameghino's *Astraponotus*-beds are a separate, definable, and nameable unit, using for it Kraglievich's name *Mustersense* (or *Musters*). Rejected by Frenguelli, accepted by the Y. P. F. and by Bordas.

(3) By rejecting correlation of the beds below the Casamayor with the Selhuense and proposing the new name Río Chico. Accepted by Frenguelli and Bordas. Definition and correlation accepted by Y. P. F. but name Pehuenche used.

The Y. P. F. report made the following additional modifications:

(4) Applying a group name "Tobas de Sarmiento" to series from Casamayor to Colhué-Huapi, inclusive.

(5) Inserting the "Tobas de Koluel-Kaike" between the Río Chico (their "Pehuenche") and the Casamayor.

Each of these disputed modifications may be briefly discussed.

(1) In 1933 I had not studied the beds at Trelew and Gaiman and accepted the then universal opinion that they were the same as the so-called *Colpodon*-beds south of Lake Colhué-Huapi. I then preferred

for this supposed unit the prior name Colhuehuapiense of Carlos Ameghino as revived by Frenguelli. In 1935 when I had studied the beds at Trelew and Gaiman, I found that they differ notably from the typical Colhuehuapiense and provisionally revived for them Kraglievich's local name Trelewense, noting that this was a partial redefinition, or a more exact definition, since Kraglievich believed his Trelewense to be the same formation as the *Colpodon*-beds of Colhué-Huapí. Frenguelli rejected my proposal on the grounds that Colhuehuapiense and Trelewense are strict synonyms and that the two deposits in question do not differ enough to warrant

ably in age, facies, or both. These deposits are widely discontinuous, are different in facies, and may be different in age. In 1935, on the basis of preliminary study of a small collection of mammals, I suggested that the Trelew beds might be later than the Colhué-Huapí. In 1939, after more detailed study of a larger collection, Bordas concluded that they are definitely later. It does not follow that the two names are of equal scope or that they are not both parts of one unit of higher rank, but these facts do warrant the use of different stratigraphic names for clarity and exactness.

Part of the difficulty here is that Fren-

Frenguelli, 1930	Simpson, 1933	Simpson, 1935	Frenguelli, 1935	Y. P. F., 1938		Bordas, 1939
Colhuehuapiense	Colhuehuapiense = Colhué-Huapi	Trelewense = Trelew ?	Colhuehuapiense	Sarmiento	Colhué-Huapi	Trelewense
		Colhué-Huapi			Colhuehuapiense	
Deseadense	Descadense = Descado	Deseado	Deseadense		Descado	Deseadense
	Mustersense = Musters	Musters			Musters	Mustersense
Casamayorence	Casamayorence = Casamayor	Casamayor	Casamayorence	Casamayor	Casamayorence	
Sehuenense	Ríoichiense = Río Chico	Río Chico	Ríoichi-quense	Koluel-Kaike		Ríoichi-quense
				Pehuenche		

the introduction of a new name for one of them. But by absolute tautonomy and the explicit intentions of their authors, the type locality of the Colhuehuapiense is the barranca south of Lake Colhué-Huapí and that of the Trelewense is the region of Trelew (and its neighboring village, Gaiman). The synonymy depends on the correlation of these widely separate deposits and if these are not the same thing the terms are not synonymous even if their authors thought that they were. The difference between the two type deposits is not great but it is real. General usage throughout the world sanctions and demands the use of separate local names for stratigraphic units if they are discontinuous geographically and if they differ appreci-

guelli, like many other stratigraphers, is attempting to set up a standard column for all of Patagonia or of the Argentine and to maintain that terrestrial deposits of (about) the same age necessarily represent the same formation (or horizon or stratigraphic stage). As discussed on a later page, I believe such an arrangement to be impractical because it confuses age units with rock units, two quite different things.¹

(2) I am engaged in a revision of the Musters fauna, to appear later. It will save confusion to state now that Ameghino was correct in thinking that this

¹ Incidentally the discussion would be on a somewhat different basis if Trelew had been a new name when I used it, but it was not.

fauna is distinctive either from Deseado or Casamayor and not merely a phase of one or the other. On the whole it is closer to Casamayor than to Deseado, but as far as the typical faunas are concerned it is separated by marked hiatuses from both. The stratigraphic development of the Musters formation is limited in the few localities where it has been studied, but there are indications that it has a large development in regions not yet sufficiently explored. Even now it can be recognized as a definable rock (as well as faunal) unit, readily separable from the Deseado where both occur.

(3) The essential character of the Río Chico formation or series and its Tertiary, not Cretaceous, age is now generally accepted. Such disagreement as exists is mostly nominal, whether to call these beds Río Chico or Pehuenche. The history of the name "Pehuenche" has been discussed by Frenguelli, me, and the Y. P. F. geologists and need not be repeated beyond stating these undisputed facts:

The type Pehuenche of Doering, 1882, is certainly of Cretaceous age and is exposed near Roca in northwestern Patagonia. It is probably synchronous with, but as a rock unit is quite distinct from, beds in central Patagonia.

Ameghino at various times (e.g., his great work of 1906) used the name Pehuenche for certain beds in central Patagonia immediately below the Salamanca. This was not a proposal of a new name or a new definition. It was a correlation with the type Pehuenche. The beds so correlated by Ameghino are, like the type Pehuenche, indubitably of late Cretaceous age; they probably are later than the type Pehuenche, although this is uncertain.

For some forty-five years the name Pehuenche was in common use and was used only for beds supposed to be (and in almost every case correctly) Cretaceous in age and on the basis of correlation (usually not exactly correct) with the type Pehuenche. It is still used by various workers in this sense.

But a decade or so ago some of the Y. P. F. geologists began applying the name to beds above the Salamanca, mostly

in the mistaken belief that they were Ameghino's Pehuenche (they were really his "Notostylopense basal") and in the equally mistaken belief that they were of Upper Cretaceous age.

Whatever can be said of Ameghino's Pehuenche, the Y. P. F. Pehuenche certainly has nothing to do, in age, facies, or fauna, either with Ameghino's Pehuenche or with the type Pehuenche. The Y. P. F. geologists defend their usage only on the basis of its general adoption, but it is, as they admit, absolutely incorrect and extremely confusing and the "general adoption" is only in recent years and only in their own work, most other students rejecting their error. The general adoption of an error (even when it is general) is not a very sound argument for its perpetuation after its falsity has been exposed. I can only express entire agreement with the Y. P. F. geologists when they say that "it would be wisest to abide by the name Río Chico" and that this "offers the advantage of not lending itself to confusion," with surprise that they themselves see fit to reject what they designate as the wise and proper course in the matter.¹

(4) Field workers doing gross reconnaissance have generally given one name to the whole tuff-bentonite series between the Río Chico and the Patagonia formations. It is true that it is difficult to trace or map formational units in this series on lithology alone. The lithology is remarkably varied in detail but similar in the mass. Units well recognizable in a given section usually cannot be traced far laterally. From the practical point of view of rapid and crude mapping, and especially for the oil geologist who has no immediate interest in these nonpetroliferous deposits, there is, then, some advantage in the use of such a broad name, and that now proposed by the Y. P. F., "Sarmiento," is acceptable and greatly preferable to those previously used, some of which were ridiculous (e.g., Windhausen's "tobas mamíferas").

¹ Since this paper was written, the Y. P. F. has published an excellent geological map of Patagonia by Dr. Feruglio. On this the beds in question are called *Riochiquense* "which in Chubut is customarily referred to the Pehuenche."

On the other hand, for the progress of careful work and detailed stratigraphy, such a term may do as much harm as good. From a temporal point of view, it is of unwieldy size, covering all the strata deposited during about two epochs, and perhaps part of a third. At every locality where I have seen these rocks, it is always possible by careful work to define the age of a particular exposure far more exactly than this. Although often sparsely fossiliferous, these rocks do everywhere contain some fossils. Moreover by correlating the well-defined but variable lithologic variations with fossil discoveries, it is entirely possible in any given region to divide this series into valid and recognizable stratigraphic formations. Since, as far as has been shown, this can always be done when the effort is made, the use of a single name for the whole series is not a real necessity and may tend merely to retard necessary progress in the study of these very important strata and their faunas.

(5) The Y. P. F. name "Koluel-Kaike" applies to a purely lithologic unit (if it is a unit), Ameghino's "argiles fissilaires,"

which usually occurs between the Río Chico and the Casamayor. Since more or less similar rocks do, less commonly, occur at other levels, this is not a proper stratigraphic term unless it is defined not only by lithology but also by the specification of its being confined to the more or less continuous sheet of such rocks below unsilicified tuffs with Casamayor fossils in southern Chubut and northern Santa Cruz territories. Even this sheet, although a proper stratigraphic (not temporal or faunal) unit is probably of somewhat different ages in different places. It is probably usually contemporaneous with the oldest parts of the Casamayor. No fossils have been found in it. It probably has no proper place in a generalized Patagonian stratigraphic column, and certainly does not now belong in a generalized time scale for the region. My present opinion is that it does not represent any time not also represented by fossil-bearing strata of different name and character in Patagonia, although of course this opinion is subject to correction by discovery of new facts.

TIME, ROCKS, AND FAUNAS

As in North American geology, the stratigraphic taxonomy of Argentina has been confused by a lack of clarity in distinguishing units and names applicable to rocks, to faunas, and to time. The following summarizes the taxonomic arrangement sponsored jointly by the Association of American State Geologists, the U. S. Geological Survey, the American Association of Petroleum Geologists, and the Geological Society of America (reference under Ashley, etc., 1933).

The names in parentheses are mentioned but not explicitly recommended by the

report in question. That in brackets is not mentioned but has recently come into general use, especially by vertebrate paleontologists.

Eras, periods, and epochs have world-wide names, familiar to all of us, e.g., Paleozoic, Cretaceous, Eocene. Subepochs, ages, and phases, if named, have provincial names that are not world-wide but apply over as large an area as can readily be involved in fairly precise chronologic correlation, e.g., Pontian in the Old World or Lutetian in Europe, names geographic in origin and, as a rule, with the ending -an

Time		Rocks		Faunas	
Era	} Theoretical equivalence	(No name)	} (No faunal name)		
Period		System			
Epoch		Series			
(Subepoch)	} Approximate but not necessarily exact equivalence	Group	} No specified equivalence		
(Age, Stage)		Formation		Zone	
(Phase)		Member (Stratum)		[Local fauna]	

in English. These names are commonly, but not by technical necessity, derived from those of included or approximately equivalent rock units.

Systems have the same name as the corresponding periods, and series may have the names of epochs or may have provincial geographic names. Groups, formations, and members have geographic names, used in North America without modification or special termination. A single stratum is not usually named.

Zones are given faunal (or floral) names, from a genus, species, or occasionally subspecies that characterizes each. There is a tendency for vertebrate paleontologists to deprecate their use as unnecessary and essentially undefinable, a feeling that I share, generally speaking. In some cases, however, they are useful, or are considered so by many teachers, stratigraphers, and some paleontologists, so that it is desirable to supply them when conveniently possible. Local faunas are given the names of the localities where they occur, without entering into questions of priority, synonymy, etc., involved in the more formalized use of geographic names for rock and time units, e.g., one may speak of a lower Casamayor local fauna at Colhué-Huapí without meaning or implying any

North American Arrangement	Y. P. F. Arrangement
System } Series }	Used but not explicitly defined
Group	Complejo
Formation	Formación
Member	Sección

The Y. P. F. arrangement uses the world-wide system and series names in Spanish forms, e.g., Terciario, Senoniano, Triásico. For the smaller and more explicitly rock units, they generally use unmodified local geographic names, e.g., Complejo porfirico de Bahía Laura, Tobas de Sarmiento, Estratos de Bustamante, Formación de Roca, Chubut. Occasionally they use the more classic Argentine terms in -iano and -ense, without explicit differentiation of their rank, e.g., Rionegrense, Santacruciano. They do not, as a rule, use the same name for a "complejo" and any one of its included "formaciones" or for a "formación" and any included "sección."

The arrangements of Kraglievich and Frenguelli, the former derived from Ameghino without essential change and the latter a modification of Ameghino's arrangement, are as follows. Their equivalence with the North American arrangement (published later) is not conscious or intended to be exact, as is that of the Y. P. F.

North American Arrangement	Kraglievich 1930	Frenguelli 1930
System	(Not used)	Sistema. -ico
Series	Formación. -ana	Grupo. -iano (Usually with scope of a series)
Group	Horizonte. -ense (Usually with scope of a formation)	Horizonte. -ense (Usually with scope of a formation)
Formation		
Member		

relationship to the Colhué-Huapí formation or to a Colhuehuapian age.

There is no thought of imposing this arrangement in the United States or anywhere else, but it does provide a reasonably standardized synthesis of widespread usage. As such it is cited in the Y. P. F. report which, for rock terms, specifies equations between its Spanish and the English of the North American report, as follows:

Kraglievich and Frenguelli use provincial geographic names (even for systems, in the case of Frenguelli) with the endings indicated.¹ They commonly use the same name with different endings in different senses, which is clear enough as they use

¹ Ameghino did the same, sometimes with geographic names and sometimes with generic zoologic names, e.g., Paranaense from Paraná, a geographic locality, *Notostylopense* from *Notostylops*, a fossil mammal.

it but confusing to anyone not well acquainted with Argentine geologic literature. For instance, Kraglievich's "Fria-seana" includes a much smaller "Fria-sense" along with two other "horizontes," and Frenguelli's "Patagónico" includes a much smaller "Patagoniano," just as his "Deseadiano" includes a much smaller "Deseadense."

The use of the word "formación" in Kraglievich's (and Ameghino's) sense will perhaps be abandoned, as it has been by Frenguelli and by the Y. P. F. It has some historical justification but is contrary to the most widespread modern usage. Kraglievich's and Frenguelli's use of "horizonte" was abandoned by the Y. P. F. (as was "horizon" in a similar sense in the North American report) for the cogent reason that "horizonte" in Spanish, like its English cognate word, correctly means a plane and not a unit with thickness.¹

Neither Ameghino nor Kraglievich made any clear distinction between faunal and rock names; significantly, neither one was a field worker or collector. Fundamentally and as a rule they were really studying and naming faunas, not strata, and without clear definition they extended names erected on this basis to strata, not really thinking in terms of rocks but with the implicit idea that strata must correspond with known faunas. This is shown, among many other things, by the fact that Ameghino commonly named strata for genera and used identical names for strata and for faunas, and that Kraglievich defined all his names not in terms of lithology or bounding horizons but in terms of faunas only, even calling a "formación" a "Ciclo faunístico."

Like most North American geologists, none of the Argentine stratigraphers (as far as I know) has clearly distinguished time and rock units. They speak of time, if at all, either in terms of rocks and faunas or in terms of the world-wide, not provincial, epochs and periods. There is at present in North America a strong drift

away from either of these methods and the reasons for this clearer differentiation of time and rock names and units are still more impelling in the Argentine than in the United States. A faunal zone (or a zonal fauna) may run through several formations. One formation may be of different ages in different places. Two formations may be quite distinct and yet have the same age and the same fauna, or the same age and different faunas. Clarity and convenience can only be served in such cases by having time names distinct from rock or faunal names. The use of the world-wide time names in the Argentine is particularly confusing, because they imply at least an approximate world-wide correlation, and as to this there is no consensus at present. For instance, when Kraglievich, Castellanos, Frenguelli, and Scott speak of the Later or Upper Oligocene of the Argentine, they are referring not to the same but to four different times. If they speak of the Chasicó they are at least thinking of the same fauna, and probably but more questionably of the same formation and age. Kraglievich, for instance, might be speaking of any beds or faunas that he correlated with the Chasicó on a purely faunal basis, whether or not they really were to a stratigrapher the same formation as that exposed at Chasicó. This leads back to the difficulty that it is quite impossible to do what most Argentine geologists and paleontologists have attempted but the Y. P. F. has now wisely abandoned: to build up a single standard stratigraphic sequence for the whole Argentine or even for a considerable part of it. At the same time it emphasizes the need for non-stratigraphic time terms to use in provincial correlation.

The following table is a first attempt at a system for the times, rocks, and faunas here under discussion in which these three quite different things are clearly distinguished.

The Sarmiento is here inserted as a provincial series, although not wholeheartedly approved. It is not a "complejo" in the Y. P. F. sense, equal to a "group" in the North American sense, because its actual scope is surely far greater,

¹ Ameghino also used "horizonte" or (in French) "horizon" in this sense, as did many geologists of his period, but preferred "piso" = "étage," a better term but also now usually rejected in this sense because "étage" or "stage" is generally understood to be a time, not a rock, unit

probably between that of a series and of a system. In its provincial use it corresponds more nearly with a series than with any other standard unit.

The Río Chico is very tentatively inserted as a series but can equally well, at present, be called a formation. In various

The clear distinction of age and rock names, in contrast with the previous attempts to make one set of names serve both purposes, will make possible the more exact and less ambiguous definition of all the formations in their true sense, as local rock units defined in most cases by lithology

Ages	Rocks			Faunas	
	Series	Formations	Members	Zones	Local Faunas
Colhuehuapian		Trelew	Not distinguished in any one section	<i>Colpodon</i>	Trelew-Gaiman Colhué-Huapi —and others
		Colhué-Huapi			
Deseadan	Sarnien-to	Deseado and at least one more, unnamed	Several in each formation, not yet defined	<i>Pyrotherium</i>	Canquel (2 or 3 faunules) Cerro del Humo Colhué-Huapi Cabeza Blanca La Flecha —and several more
Mustersian		Musters and probably one more, unnamed	Not distinguished in any one section	<i>Astraponotus</i>	Cerro del Humo Colhué-Huapi Cañadón Colorado —and perhaps others
		Casamayor, and probably others, not defined	Several, not defined	<i>Notostylops</i>	Colhué-Huapi (at least 2 faunules) Cañadón Vaca Cañadón Hondo Canquel —and many others
Casamayoran		?			
		Koluel-Kaike	Not distinguished	?	None
		?			
Riochican	Río Chico	Probably several, not defined	Probably several, not defined	<i>Ernestokokenia chaisioer</i> <i>Kibenikhoria</i> <i>Carodnia</i>	Palangana Gaiman Cerro Redondo Cañadón Hondo Palangana
Salamancan	?	Salamanca	Banco verde Fragmentosa Glaucóntico Lignitifero	Not defined (marine and brackish)	Many
—?		Bustamante	Not distinguished	<i>Trigonia bustamantina</i> , etc.	Several
		Lefipan			

places it probably covers most or all of an epoch, which would mean that it had nearly or quite the rank of a series. Constituent formations or members have not yet been clearly distinguished, although I have no doubt that they can and will be if more extensive and intensive work is done.

and fossils together, in some cases by lithology alone. Several of the accepted provincial age units clearly cover more than one local rock unit and further work will now permit the definition of such units without their confusion with age units. It is, of course, assumed that each age unit covers a span of time and can

correspond with rock units of appreciably but not greatly different precise ages. It is also anticipated that the discovery of strata and faunas intermediate between those hitherto described will fill in some of the great hiatuses in the sequence and lead either to redefinition of these age names or to intercalation of others, e.g., between Mustersian and Deseadan.

The chart reveals how little is really known about this sequence and that vir-

tually all the detailed and truly careful work remains to be done. For instance, the differences between two local faunas obtained from one formation have never been revealed in any case, although marked and important differences of this sort exist.¹ The sequence of the local faunas is almost completely unknown, although this is the fundamental basis of the early Tertiary history of the region.

WORLD-WIDE CORRELATION

There is no more difficult problem in South American geology than the assignment of the various terrestrial formations and provincial ages of the Argentine to their proper world-wide epochs, which can only be correctly done by correlating them with North American and European formations and ages. The data are so diffuse and so many of them, as regards the ages here considered, are unpublished and seem destined to remain so for a long time, that no full discussion or well-rounded summary is possible in this paper. It is, however, useful to point out trends of opinion and the conclusions that have so far been drawn from extensive unpublished studies.

Some indication of the differences of opinion may be gained by reviewing the ages assigned by various students to three formations from which large mammalian faunas are known:

Casamayor:

- Upper Cretaceous—Ameghino, Ihering, Doering, Roth.
- Paleocene—Gaudry.
- Paleocene and Lower Eocene—Kraglievich.
- Lower Eocene—Windhausen, Rovereto, Simpson.
- Lower and Middle Eocene—Castellanos.
- Upper Eocene—Matthew, Schlosser, Patterson.
- Lower Oligocene—Frenguelli.

Deseado:

- Upper Cretaceous—Ameghino, Doering.
- Lower Eocene—Rovereto.
- Middle Eocene—Ihering.
- Upper Eocene—Windhausen, Roth, Gaudry, Kraglievich.
- Lower Oligocene—Castellanos.
- Lower to Middle Oligocene—Simpson.
- Middle or Upper Oligocene—Patterson.
- Upper Oligocene—Wilckens, Frenguelli.

Santa Cruz:

- Upper Eocene—Ameghino, Doering.
- Middle Oligocene—Rovereto.
- Upper Oligocene—Ihering, Roth, Kraglievich.
- Lower Miocene—Windhausen, Castellanos, Simpson.
- Middle Miocene—Scott, Patterson.
- Upper Miocene—Wilckens, Frenguelli, Matthew.

(Numerous other students could be cited, but their opinions on each point would nearly or quite coincide with one included here. The table is intended only to show the general divergence of opinion and does not show the development of opinion by any one student. Most have changed their opinions at various times, but each at some time has expressed the opinion here ascribed to him. Nor is it convenient or necessary for the present purpose to show the doubts and cautions expressed. For instance, I do not by any means consider the Lower Eocene age of the Casamayor as certain, but since I do think it slightly more likely on present evidence than any other equally limited age assignment, I have listed myself as supporting this correlation.)

Disregarding, for the moment, the details of correlation, different students show different general tendencies as to the age of this part of the series as a whole. Thus Ameghino consistently made older correlations than most students and Frenguelli consistently makes younger correlations. On this basis the authors cited, as well as those not cited, can be divided with reasonable clarity into five groups, which are

¹ Some are shown by materials now in my hands and will be discussed in a forthcoming memoir.

as follows in the order of their tendency to make the series as a whole older to younger from 1 to 5:

1. Ameghino, Doering.
2. Ihering, Roth, Rovereto, Kraglievich.
3. Gaudry, Windhausen, Castellanos, Simpson.
4. Scott, Matthew, Patterson.
5. Wilckens, Frenguelli.

These do not represent schools of thought in the proper sense, but for the most part independent conclusions that happen, in each group, to coincide approximately as to age tendency. For instance, although I agree more or less with Gaudry, Windhausen, and Castellanos as to the general age and span of this part of the stratigraphic column, I reached this conclusion by independent study of the data, including much not known to them, and I believe some of their reasons for this assignment and some of their particular formation correlations to be invalid.

It has often been remarked that the Argentines tend to make this part of the series older than do non-Argentines. The tabulation here given shows that such a nationalistic bias does not now really exist. Both Argentines and non-Argentines could be listed in each group, and it happens that the leading exponent of extreme late age assignments, Frenguelli, is an Argentine.

Little approach toward agreement has as yet been indicated in correlation with advancing knowledge and new discoveries. I believe that no modern student could be placed in group 1 with Ameghino, but each of the other four, still very divergent, has competent supporters at the present time. Kraglievich supported the general age assignment of group 2 in 1930 and I believe Rusconi maintains Kraglievich's opinion today. Castellanos belonged in group 3 in 1937 and probably still does, as do I. Scott maintained the position indicated for him above in 1937 and does now as far as I know. Frenguelli's extreme views were explicitly published in 1934 and I am not aware that he has changed them significantly. Moreover each group, except the first, now includes students of considerable authority and well acquainted with

the most essential data. A weak consensus of living students would favor group 3, or a position between this and 4,¹ and this position also has the advantage of being about midway between the extremes. It is in these respects (and these only) slightly more authoritative and probable, but the question is not one that can really be settled by consensus or by compromise.

The following tabulation of correlations of all the provincial stages from Salaman-can to Santacrucian includes representatives of each of the five general groups just discussed as well as the correlations tentatively supported in the present paper. The Eocene-Oligocene boundary is indicated by a double line (one dotted if alternative positions are given) in order to make the general age tendencies more apparent.

The principal lines of evidence on which such correlations can be or have been based are as follows:

TECTONIC MOVEMENTS.—Tectonic evidence was once used as partial support for drawing the Cretaceous-Tertiary boundary below the Casamayor, but this has been shown to be erroneous and is now abandoned. The occurrence of folding and erosion between Deseadan and Patagonian is established and tends to emphasize the presence here of a hiatus in the known series, evidently between Deseadan and Colhuehupian. Since, however, this and other supposed or real tectonic phases have not been correlated with those on any other continent, their usefulness in establishing synchrony is slight or nil.

THICKNESS OF STRATA.—This means of estimating the relative durations of the various formations is at present of no value here. No valid idea of relative speeds of deposition has been gained. The series is replete with hiatuses, both intra- and interformational, of unknown duration and value. The maximum thicknesses are not well established and for some formations, notably the Musters, no good thickness determination has yet been published.

TYPE OF FOSSILIZATION.—As regards the Santa Cruz fossils, Matthew believed that the sediments in which they occur

¹ In fact the step between these is not large, being smaller, for instance, than that between 2 and 3.

and the climatic conditions were closely analogous to those of some North American fossils, like those from the Bridger and John Day, and that supposedly more recent aspect of the Santa Cruz bones was therefore suggestive supporting evidence of their more recent age. The method is tempting, but it has never really been accorded a proper scientific test. It is extremely doubtful whether even such an authority as Matthew could really judge

most recent students to be entirely inapplicable.

DIVERSITY AND FACIES OF FAUNAS.—Castellanos has suggested but has not followed the use of these vague criteria, suggesting that the fauna of the Casamayor compares in these respects with Oligocene faunas of the rest of the world. Even granting the comparison (which I think doubtful or incorrect), the age correlation does not follow, as Castellanos

Provincial Ages	Correlation					
	Ameghino 1906	Kraglievich 1930	Castellanos 1937	Scott 1937	Frenguelli 1934	This Paper
Santaerucian	Eocene (including Paleocene)	Oligocene	Lower Miocene	Lower to Middle Miocene	Miocene	Early Miocene
Patagonian			Oligocene			Latest Oligo- cene or earliest Miocene
Colhuehuapian						
Deseadan	Upper Cretaceous	Eocene	Oligocene	Oligocene	Oligocene	
Mustersian			Eocene or Oligocene		Hiatus	
Casamayoran						Eocene
Riochican	= Casa mayoran	Paleocene	Upper Cretaceous	(Paleocene absent)	Eocene	Paleocene
Salamancan		Upper Cretaceous			Paleocene	

the relative degree of fossilization without controlled analysis and could really determine that fossilization occurred in the same way and at the same rate in areas so disparate. This method seems to me now to have no value for correlation in the present instance.

PERCENTAGE OF EXTINCT FORMS.—This method is sometimes used in Pleistocene mammalian correlation and in Tertiary molluscan correlation, but many students have exposed its pitfalls. Ameghino used it to a slight extent in correlating the present series. Under the conditions here obtaining, the method seems to me and to

agrees, since he calls the Casamayor Lower to Middle Eocene.¹

GENERAL EVOLUTIONARY STAGE.—Judgment as to degree of evolution undoubtedly colors most opinions on Patagonian correlation. Some validity must be granted this sort of evidence. For instance, almost anyone familiar with fossil mammals in general would grant that the fauna of the Casamayor is Eocene (not necessarily Eocene) on this basis alone but this is not very useful because that fact is now

¹ I.e., the Casamayor in my sense, which is the usual one. Castellanos follows Kraglievich in separating Ameghino's lower "Notostrylopense" as a distinct formation, a separation resting on no valid definition

thoroughly established on more objective evidence. Whether closer and useful correlation is possible on these grounds is dubious. It assumes that the two faunal sequences to be compared, e.g., South American and North American, departed at a given time from the same basis and evolved in analogous ways and at about the same rate, and that comparable evolutionary stages can be selected with some accuracy. These assumptions are here doubtful in the extreme and become quite unwarranted when they must be applied to very unlike animals far from any common origin. In earlier times, up to about Mustersian at latest, there are, however, a few South American mammals that are not so distant from North American forms. These do give suggestive but inconclusive evidence in this field. For instance, if, as I believe, the Casamayoran didolodontids are related to the North American phenacodonts, they suggest a degree of evolution comparable very approximately to early Eocene in North America.

MAMMALIAN MIGRATIONS.—This is the surest method of Tertiary intercontinental correlation and the principal one in use in the northern hemisphere. In South America it is of the greatest importance in correlating Pliocene and Pleistocene deposits, but of little or no use in the earlier Tertiary beds here under consideration because there is no clear evidence that any mammalian migration into or out of South America occurred while they were being laid down. The possible exceptions are the hystricomorph rodents, appearing in Deseadan times, and the ceboid primates, appearing in Santacrucian times (or possibly a little earlier), but these do not help, either, because their appearance cannot yet be definitely tied in with origin and temporal sequence in any other continent. The only important datum here is that the Riochican, with mammals surely Tertiary in type, can hardly be older than Paleocene or (even at the top) younger than early Eocene, a rather vague conclusion but one of considerable importance.

MARINE CORRELATION.—The marine beds, unlike those of terrestrial origin, include numerous forms of life that were not

confined to South America during the time here considered. They therefore afford an opportunity for correlation more exact and more firmly based than that of the terrestrial deposits. Their information is not entirely conclusive, as is shown by the fact that different students still do not agree as to the age of the rich Patagonian marine fauna, but it is the best available. This, then, is the real limiting basis of correlation for this sequence. Two marine deposits are included, the Salamanca and the Patagonia formations (which, of course, are, respectively, Salamancan and Patagonian in age). Salamancan time is older than Riochican, but probably grades into the latter because the deposits here suggest a transition rather than a break (but this is not altogether certain). A transition from Colhuehuapian to Patagonian is more certain, indeed the later Colhuehuapian deposits are supposed by most students to be contemporaneous with the first marine deposits of the Patagonian. Generally speaking the two stages are successive, but probably with no intervening hiatus.

The Salamancan has long been considered Cretaceous, and successive students have tended to consider it as younger and younger. For Ameghino it was Cenomanian and for most of his successors Senonian. Now Feruglio (1937) has emphasized the absence of indubitably and fully Cretaceous guide fossils and tentatively calls the Salamancan, Danian. On the basis of Feruglio's excellent study, and without essential contradiction of his own conclusions, there is considerable likelihood that the Salamancan is really earliest Tertiary (early Montian, or in the North American sequence, Puercan) or perhaps transitional Danian-Montian. I would so correlate it, and on this basis I believe that the overlying series cannot begin earlier than about the middle or possibly the early (but probably not basal) Paleocene and probably does not begin much later than that. The relations of the Salamanca formation in Patagonia may be closely analogous to those of the Cannonball in North America.

The Patagonian has always been con-

sidered Tertiary, which is unquestionably correct, but more exact correlation varies from early to middle Eocene (Ameghino) to about middle Miocene (Frenguelli). More than any other one factor, it is the age given the Patagonian that determines the general correlation groups discussed above. As far as I know, recent students vary in assignment from about middle Oligocene to about middle Miocene—a surprising divergence for so large and relatively well-known a marine fauna. The evidence and arguments are too lengthy for review here, involving as they do molluscs, crabs, echinoderms, corals, bryozoans, sharks, penguins, whales, and other fossils. Despite the differences of opinion, there seems to me to be a definite probability that the formation (at least the typical Patagonian as distinct from Superpatagonian) is of earliest Miocene or transitional Oligocene-Miocene age. I do not think that the most reliable, well-evaluated data can be reconciled with age assignments as early as middle Oligocene or as late as middle Miocene. On this basis the Colhuehupian, very little earlier than Patagonian and perhaps partly contemporaneous with the oldest marine Patagonia, is probably late Oligocene, while the Santacrucian, only a little later than Patagonian, cannot be older than earliest Miocene or younger than middle Miocene. I tentatively place it as early (but not earliest) Miocene.

INTERNAL EVOLUTIONARY ADVANCE.—With limits thus set approximately by the marine beds, the problem becomes one of distributing the various provincial stages from Riochican to Colhuehupian in the Paleocene to Oligocene, inclusive. There is no firm basis for doing this other than judgment of lapse of time by the evolutionary changes seen in the corresponding mammalian fossils. The Riochican includes certainly two and probably three distinctive faunas, and the fossils of the older Riochican are very poorly known. In itself, this stage suggests a lapse of time probably great enough to include both middle and late Paleocene. There is no significant gap (but there is a definite progressive step) from latest Riochican to

earliest Casamayoran mammals. The Casamayoran fits in best as about early Eocene. There is a marked gap between Casamayoran and Mustersian (as their characteristic faunas are now known). This gap may cover part or all of middle Eocene, possibly part of lower Eocene, and the Mustersian fits in as around the middle-late Eocene transition. Then, in the known faunas, comes another and still larger break which may represent part or all of late Eocene and part or (less probably) all of early Oligocene, and the best characterized Deseadan fauna would be near the early-middle Oligocene line. The next hiatus, also well marked but probably less in value, probably represents part of late, possibly (less probably) also part of middle Oligocene, and the Colhuehupian falls into the latest Oligocene, as suggested by its relations to and the correlation of the Patagonian.

This arrangement is fully consonant with the actual evolution that occurred, as I now see it, and the more markedly different correlations that have been proposed do not well fit these considerations. Thus according to Kraglievich the early Casamayoran (to which he gives a different name) represents the Paleocene and the later Casamayoran the early Eocene, but there is exceedingly little advance from earliest to latest Casamayoran,¹ certainly far too little to permit such age assignments.

As an example of opposite tendency, Frenguelli (1934) puts Casamayoran to Deseadan all in the Oligocene and here, even allowing evolution then to have been relatively more rapid than in post-Oligocene South America, the changes seem to me much greater than occurred among autochthonous mammals in the Oligocene of North America or Europe. This amount of evolution is too great to be crowded into the Oligocene and accords far better with the span of the Eocene (which was longer than the Oligocene) plus part of the Oligocene.

¹ As a matter of fact none has ever been actually demonstrated, but new data now in hand suggest that there were slight changes, distinctly less than those from Gray Bull to Lost Cabin in the North American early Eocene.

These broad considerations, involving many detailed data not here listed, have

led to the tentative correlations given in the last column of the preceding table.

THE GAIMAN REGION

My study of the Gaiman region (1935a and b) was severely criticized by Frenguelli (1935) and later generally supported by Bordas (1937, 1939) incidental to the description of a new fauna from there. The principal points in dispute are these:

(a) Local correlation of stratigraphic levels north and south of the Chubut River near Gaiman.

(b) Existence and character of an angular unconformity in this series.

(c) Presence of a terrestrial horizon in the strata designated as marine by Frenguelli in 1927.

(d) Broad correlation of the pre-Patagonian strata in this series.

(e) Presence of a lateral wedge of the formation mentioned in (c) north of the river.

(f) Presence of land mammals in the littoral marine Patagonian beds.

(g) Use of the stratigraphic names Trelew, Colhué-Huapi, and Musters.

As regards (a), (c), and (d), Frenguelli is now in substantial agreement with my conclusions. Bordas has also confirmed these conclusions and has strengthened them, notably in establishing that certain beds considered by Frenguelli in 1927 as Patagonian (Oligocene or Miocene) on one side of the river and Cretaceous on the other side are really Casamayor (Eocene) as I believed but could not rigidly prove in 1935.

At present, then, these points may be taken as settled, to the extent of agreement by all who have examined the evidence at first hand. The nomenclatural dispute (g) has been discussed on previous pages.

Regarding (b), Frenguelli in 1927 showed a strong angular unconformity in the strata on both sides of the Chubut River, involving an anticline in the older beds, shown as dipping away from the river on both sides, with the younger strata nearly horizontal above them. My conclusion (1935a) was that "it is to be expected that small angular unconformities exist, but the evidence is still lacking. If they are present, it seems almost certain that the angle involved is less than a degree." In

1935 Frenguelli reaffirmed the existence of an angular unconformity, but added that it is slight. He said that he could not otherwise interpret the details of two photographs (Frenguelli 1927, Figs. 40 and 41) and that it is not difficult to see angular unconformities on both sides of the valley. The photographs cited do not, in fact, show any angular unconformity but only isolated exposures of tilted and folded beds. I have already (1935a) confirmed that such tilted beds do exist but have shown that there are two possible alternative explanations for them, neither of which is consistent with Frenguelli's supposed angular unconformity or its supposed underlying anticline. Frenguelli did not discuss these possibilities in his later paper.

As regards the ease of observation of the supposed angular unconformity, I did not observe it, although I searched for it at the exact places indicated by Frenguelli. It is significant that Frenguelli claims throughout that there is only one unconformity of this nature but that in 1935 he shows it at an entirely different place from that indicated in 1927. It can hardly be easy to see if Frenguelli does not see it now where he did in 1927 and did not see it then where he does now. Bordas does not specifically discuss this question, but his general interpretation is contrary to the reality of Frenguelli's unconformity.

Of course any large erosional unconformity, such as certainly exists here, is likely also to be angular if the term be extended to dip differences of a fraction of a degree, but this has little tectonic and no economic significance. In parts of the meseta region there was folding after the Deseado and before the Patagonian depositional phases, as I can prove from observations made elsewhere, but the effect in this particular area was insignificant as far as present evidence shows. The question is local, but it has broad importance because just such questions of localization

are vital in the general interpretation of tectonic phases.

As Frenguelli notes, the only appreciable purely stratigraphic (non-structural) difference between my views and those that he reached after mine were published (but not before) is on point (e), that he denies the presence north of the river of the terrestrial horizon that he calls Colhuehuapiense and that I call Trelew or Trelewense. I noted that this level is there represented by mere lenticular remnants, absent in places and conformable with or even grading into the overlying marine beds. We agree that this formation is here wedging out, and the only difference is that I recognized its last traces on this side of the river and Frenguelli did not. Bordas confirms my observation.

Regarding (f), Frenguelli had reported the discovery of land mammals in marine beds. I pointed out that this is entirely possible, but that the available evidence was inconclusive because Frenguelli did not distinguish between truly marine (littoral) beds and others nearby of terrestrial deposition. In 1935 he stated that the fossils were really from the redefined marine beds, an observation that I do not question now that it is made precise. It is also confirmed by Bordas.

It might appear from Frenguelli's 1935 paper that he had previously corrected all the essential misinterpretations in his earlier work and that I wilfully omitted crediting him with these corrections. He has suggested (personal communication) that I write another note to clear up this matter. The point was not important enough for special publication, but the present paper gives occasion for brief mention.

Frenguelli's corrections after his 1927 paper and before mine of 1935 consisted of stating (1930) that he had found the "Colpodonense" with land mammals in the base of the Patagonian and that he had found Casamayor mammals west of Gaiman above his supposed angular unconformity. Both these observations had already been made many years before any of Frenguelli's papers, by Ameghino (1906) and by Roth (1908). These prior dis-

coveries were recorded along with Frenguelli's views in my historical résumé of the subject. I clearly dated his opinions and did not say or imply that he did not hold other views before or since the dates of his quoted publications. It did not seem necessary to me, in a rapid historic summary, to credit him with the discovery in 1929 of facts known more than twenty years earlier. As a matter of fact we still do not know what effect these repeated discoveries had on his opinions prior to publication of my paper, because in his publication between 1927 and 1935 he located them only with respect to an unconformity that he placed at very different levels in 1927 and, after reading my paper, in 1935.

Frenguelli is mistaken in saying (1935) that I believed his errors to have arisen chiefly from his belief in an angular unconformity and ignorance of the presence of Tertiary mammals in his complex "x," which he had called Patagonian marine but which includes also Casamayor and Trelew or Colhué-Huapí terrestrial beds. The stratigraphic sequence and correlation, which were the major points at issue, are not in the least influenced by the angular or non-angular nature of the unconformity, and I noted that Frenguelli and I and others before us had found Tertiary mammals in his series "x." To suppose that these were our chief points of difference overlooks all the real essentials of the matter.

Frenguelli's belief that I unjustly criticized his correlation of the beds now called Río Chico and his use of the name "Pehuenche" can only be a misunderstanding. In that paper (1935) I did not mention his use of the name "Pehuenche" and I had elsewhere credited him with being one of the few recent authors who avoided definite misuse of the name (the fact that in doing so he proposed equally invalid nomenclature is now beside the point). I simply mentioned his determination of these beds as Cretaceous as a fact that he had himself placed on record. I did not adversely criticize this determination, but showed that it was natural enough at the time and was disproved only by later

study. As a matter of proportion, readers of Dr. Frenguelli's polemic reply may not realize that my paper was not devoted to his work and was not a critical review. It was a record of my independent observations in the field and my interpretation of them. As is proper and necessary, I briefly summarized previous opinions, including those of Frenguelli among various others.

Dr. Frenguelli, subsequent to the appearance of my paper on the Gaiman region, emphasizes the essential agreement

of his opinions and mine and suggests that I should have confined my criticism to matters of detail. It is not as clear in Frenguelli's paper as I am sure he meant it to be that his present agreement with me is *ex post facto*, following his reading of my paper (1935a). When that paper was written all his prior explicit, published statements differed very materially and not merely in detail from the views that I then reached on the basis of my own observations and with which he now agrees.

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A NEW *PEROMYSCUS* FROM WESTERN HONDURAS

By G. G. GOODWIN

Among the mammals obtained by C. F. Underwood in Honduras are more than two hundred specimens of *Peromyscus*, representing four known species and an apparently undescribed form. The characters in this new mouse are so marked that it seems advisable to describe it as a distinct species.

Acknowledgment is due to Major E. A. Goldman of the U. S. Biological Survey who has kindly compared this new mouse with the series in Washington and has given me the benefit of his much valued opinion.

Peromyscus hondurensis, new species

Honduras White-footed Mouse

TYPE.—No. 126742, Amer. Mus. Nat. Hist.; adult, sex not given; Muya, a hill covered with second growth timber about 5 miles north of Chinacá, altitude between 3000–4000 feet, department of La Paz, Honduras; collector, C. F. Underwood, February 24, 1937. The type is a skin and skull in good condition. Besides the type there are two topotypes and six specimens from Cerro Pucá, Gracias.

GENERAL CHARACTERS.—A small, tawny white-footed mouse with moderately large ears, and tail about equal to the length of head and body. It is evidently allied to *P. lophurus* Osgood from Western Guatemala but larger with shorter pelage, paler color, and skull more rounded than the latter.

DESCRIPTION.—General color of upperparts cinnamon brown, darkened along mid-dorsal

line with an admixture of black hairs; sides of body bright ochraceous tawny mixed with black, becoming clear tawny along lateral line and on cheeks; a narrow dusky ring around eye; hind limbs blackish mummy brown above ankles, this color extending below ankle on upperside of foot; fore and hind feet white. Tail covered with fine short hairs, dusky above, whitish below; the line of demarcation fairly well defined; underparts including underside of fore limbs white with base of hair dark neutral gray.

MEASUREMENTS.—Type, topotype in parentheses. Total length 213 (215); tail vertebrae, 102 (107); hind foot, 24 (24), in dried skin 25 (25); ear, 17 (17), in dried skin 16.3 (14.5). Skull: greatest length, 29.4 (29.2); basilar length, 22.2 (22.2); length of nasals, 11.5 (11.8); zygomatic breadth, 14.7 (14.9); interorbital breadth, 4.7 (4.6); palatine foramina, 5.2 (5.4); maxillary toothrow, 4.8 (4.8).

REMARKS.—*Peromyscus hondurensis* is apparently related to *P. lophurus* but is somewhat paler in color with shorter pelage and nearly naked instead of well-haired tail; the skull is distinctly of the *lophurus* type but somewhat broader between the orbits, decidedly higher and more rounded. Specimens from Cerro Pucá, Gracias (6600 ft.), average longer tails than the type series and show a slight variance in cranial characters. The locality Humuya, La Paz, marked on the labels, is misnamed by the natives. The correct locality is Muya, Humuya exists but in another direction where Underwood did no collecting.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 33

A NEW RACE OF QUAIL FROM NEW GUINEA; WITH NOTES ON THE ORIGIN OF THE GRASSLAND AVIFAUNA

By A. L. RAND

The following is a description of a new quail discovered in the Snow Mountains by the 1938-1939 New Guinea expedition, with a note on the origin of grassland areas in New Guinea.

Excalfactoria chinensis novaeguineae, new subspecies

TYPE.—No. 306382, Amer. Mus. Nat. Hist.; ♂ ad.; at 1600 meters on the Balim River, Snow Mountains, Netherland New Guinea; December 15, 1938; Richard Archbold A. L. Rand and W. B. Richardson.

DIAGNOSIS.—Intermediate between *australis* and *papuensis* in the male by having the bright varied pattern of the upperparts like *australis* and the distribution of color of the underparts as in *papuensis*. The male differs from specimens of *australis* from Queensland and New South Wales in having the chestnut area in the abdomen of lesser extent; and in its average slightly smaller size (wing—61-68 mm. against 68-76 mm.). The male differs from examples of *papuensis* from Mafulu in having both the chestnut and the blue-gray of the underparts paler; in having the pale central crown stripe prominent; in the gray-brown edgings to the rest of the crown feathers being pronounced; in the rest of the upperparts having a much brighter, varied pattern, with the lighter brown markings conspicuous and the light colored shaft streaks more evident; in the scapulars and wing coverts being much less bluish. In the female very similar to *australis*; differs from *papuensis* from Mafulu in having the brown markings of the upperparts somewhat brighter.

WING.—♂ (10) 61-68 mm. (av. 65.6); ♀ (10) 65-70 (av. 67).

RANGE.—Known only from the Balim Valley, between 1600 and 2200 meters altitude.

REMARKS.—It is interesting that while this race approaches the Australian race in the color of the upperparts, the birds examined from the lowlands of south New Guinea show no such tendency, and are very similar to typical *papuensis*.

The Balim Valley, from which this new race of a strictly grassland bird is known, contains an area of completely isolated grassland averaging about 10 miles wide by 40 long, and varies from 1200 to 2400 meters in altitude. Since six species of grassland birds are known to occur commonly in this ecologically isolated habitat, it is interesting to consider the possible origin of this area of grassland, and its birds.

Physically¹ this valley lies in part north of Mt. Wilhelmina, one of the highest peaks of the Snow Mountains, but it breaks through the central range and drains to the south coast of New Guinea by way of the Reiger River. An area of broken mountains separates it from the lowlands of north New Guinea. Though this area of grassland is isolated, there are, scattered over the New Guinea mountain valleys, both to the east and the west, similar areas of mid-mountain grassland, and in the lowlands of north New Guinea are swamps and other types of grass areas. In south New Guinea there are also extensive savanna areas (for references to maps and comments see Rand and Brass, 1940, Bull. Amer. Mus. Nat. Hist., LXXVII, pp. 373-376).

The savannas of south New Guinea are undoubtedly an extension to New Guinea of the "open forest" climax of Australia (Rand and Brass, *loc. cit.*). The grassy marshes are not climax, but their presence is of long standing, though their area and position are continually shifting. The rest of the more or less stable areas of grasslands (below alpine grassland) in New

¹ For a description of the Balim Valley see Archbold, 1941, Nat. Geog. Mag., LXXIX, pp. 315-338.

Guinea are probably the result of man's continued activities. Certainly this is true of the grasslands the Archbold Expeditions have examined in the Snow Mountains, in southeast, and in north New Guinea.

This brings us to the question as to how there are birds, some of them endemic, living in these areas of secondary grassland.

The most evident solution is that discussed by Rand and Brass (*loc. cit.*) and Archbold and Rand, 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, pp. 534, 556, 557. There have always been small areas of disturbed conditions, on eroded areas, on landslips, where trees have fallen, where streams have shifted their course, and in marshes. Though always changing their position they are always present. And it is in such places that examples of open ground flora and fauna exist in a virgin forest. Man, extending disturbed conditions over a larger area, simply extends the available area in which these colonizers of disturbed conditions can spread.

It may be well to consider the distribution and affinities in New Guinea of the grassland birds occurring in the Balim Valley.

The species *Lonchura terrinki* is known only from the Balim Valley; its exact relations are difficult to determine, but it is one of a group of boldly patterned New Guinea *Lonchuras*. *Excalfactoria chinensis novaeguineae* is known only from the Balim Valley; it is intermediate between *papuensis* from southeast and south New Guinea and the Australian *australis* (see above). *Malurus alboscapulatus balim* is also known only from the Balim Valley; its relationships are plainly with the south New Guinea races of the species.

Saxicola caprata belensis is known from the mountains of southeast New Guinea and the Balim Valley; another form replaces it on the Huon Peninsula and in north New Guinea near Hollandia. *Cisticola exilis diminuta* occurs in southeast and south New Guinea as well as the Balim Valley; another form occurs in north New Guinea near Hollandia. *Megalurus timo-*

riensis macrurus occurs in the Balim Valley and southeast New Guinea; quite different races replace it in north, south and west New Guinea.

There are also several species of grassland birds which occur at similar altitudes in southeast New Guinea, and might be expected in the Balim Valley, such as *Lonchura grandis*, *Synoisicus ypsilophorus*, *Lanius schach* and *Mirafra javanica*, but which were not found there despite extensive hunting.

The main point the ornithological data bring out is that the different species of grassland birds probably have colonized the Balim Valley at different times: one has been there long enough to develop specific characters; two subspecific characters, and one of these latter definitely has closer relationship with south New Guinea, the other not; three others have not been isolated long enough to differentiate races; two of these have relationship with southeast New Guinea. There are also other species which have not yet appeared in the Balim Valley, but may be expected.

This indicates colonizing. But the question of the antiquity of this colonizing from an ornithological standpoint can only involve one in a fruitless argument as to how long it takes for a species or a subspecies to evolve. There is definite evidence from the ecological aspects, showing that man's activities are maintaining and spreading these grasslands; we have seen them in various stages of formation (Brass, Jour. Arnold Arboretum, in press) and the inference is fairly sure that they are secondary. Indirectly we can conclude that the grassland birds of the mid-mountains originally inhabited savannas, marshes, or small, shifting areas of disturbed conditions, and with the activities of man extending these, the birds have spread to occupy them. The endemism of some, the presence of some non-endemics and the absence of some species for which the area seems suitable, indicate a gradual colonization. It seems to have come from the east or the south, not the north or west.

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THE SPECIES OF *HOPLOPHONEUS*

BY GEORGE GAYLORD SIMPSON

Recent expeditions in charge of Albert Thomson have added several fine specimens of *Hoplophoneus* to the American Museum collections from the "Oreodon beds," lower Brulé or Orella, of the Big Badlands of South Dakota. Routine identification of these specimens for cataloguing revealed that none of the supposed species of this genus has really been defined in a distinctive, valid way and led to extensive research on the literature and on our specimens. This study did not result in a definitive revision of the genus, but it does

clear away some of the existing confusion and has some aspects of general interest. A summary of its results is therefore presented in the following comments which are merely notes, omitting most of the detailed data on which they are based and making no pretense of monographic treatment or conclusive value.

The morphology of the genus has been so well described and illustrated in the studies cited at the end of this paper that no illustrations need be given here.

TAXONOMIC HISTORY

Taxonomy, especially that of fossil vertebrates, tends to go through four stages of increasing sophistication. In the first stage, now entirely past, taxonomic categories were used very broadly. Workers were more concerned with resemblances than with differences and tended to place together all animals that resembled each other to any noteworthy degree. Students then commonly failed to make real distinctions, but they seldom made unreal ones. In the history of *Hoplophoneus* this stage involves only Leidy's work. He described two very different species now referred to this genus, and these, incidentally, appear to me to be the only species of the six described before 1920 that are surely valid.

In the second stage of taxonomy, which still persists as a lively historical hangover, students are fascinated by differences, to which alone they pay much attention. They seem to assume that the taxonomic rank and reliability of the morphologic characters of a specimen are in direct proportion to the magnitude of their deviations from those of allied specimens. This leads to splitting in a special sense, not necessarily that of giving taxonomic groups

unduly high rank (although this may also be done), but that of recognizing too many groups. Under this system it is unlikely that two different groups will be falsely united, but it is inevitable that single groups will be falsely divided. Cope, Williston, Adams, and Thorpe attacked the taxonomy of *Hoplophoneus* while in this historical stage, adding to Leidy's two species seven others of which I believe only one to be (somewhat doubtfully) valid.

A third stage, now predominant in most paleontological work, is a natural reaction from the second, with a tendency to swing back toward the first, which, however, cannot now be reached again because of the great accumulation of impedimenta inherited from the second. The concept of variability here becomes basic in taxonomic work. Differences are noted, as before, but unless they are very pronounced or, especially, qualitative as well as quantitative, they are commonly denied taxonomic value, or it is believed that their taxonomic value cannot be determined. A defeatist attitude regarding the recognizability of real minor groups is common and it is often

felt and sometimes said that paleontological species have no particular value or cannot be recognized objectively and are convenient artifices rather than expressions of natural truths. In the history of *Hoplophoneus*, Sinclair, Scott, and Jepsen have exemplified this stage, Jepsen formerly suggesting that the Linnaean system may be hopelessly unsuited for use on such material and Scott and Jepsen virtually abandoning the attempt to revise species and considering only genera as really distinctive.

The fourth stage, which is perhaps now being reached in vertebrate paleontology, approaches the subject from a combination of these earlier points of view and takes an essentially new attitude in the interpretation of their data. Resemblances and differences are equally studied and stressed and the concept of range of variation within a group is accepted as basic. Minor natural groups, including species and even, at times, subspecies and races, are believed to be recognizable from paleontological materials and the method of their recognition and study are to consider the collected specimens as samples from which inferences as to the probable limits of the natural population are to be made by orderly methods. Objective estimates of population variation developed from the theory of probability and sampling are made. It is recognized that the differences between two real groups may be less than those within one of them and that it is not simply the magnitude of differences that determines their significance but the variability involved and the associations between different characters and different types of data. The present paper does not succeed in taking the taxonomy of *Hoplophoneus* fully into this stage, but it attempts to direct study toward it.

The first species now placed in *Hoplophoneus* was named by Leidy as *Machairodus primaevus* in 1851. He later placed it in *Drepanodon*, under the (mistaken) impression that this was the valid name for European saber-tooths.¹ In 1869

Leidy described a second, much larger species as *Drepanodon occidentalis*. In 1873 Cope described a species *Machairodus oreodontis* and in the following year removed it to a new genus *Hoplophoneus*, of which it became the type. The original definitions of both species and genus were based on errors or misconceptions but in his definitive work of 1885 Cope gave an essentially correct description and placed Leidy's two species in his genus (along with a species from the John Day, not reviewed in the present paper). In 1895 Williston briefly described another Oligocene saber-tooth as *Dinotomius atrox*, making no comparison of his new genus with *Hoplophoneus* except to say that the coronoid process was much as in the latter.

The first general revision of the genus was that of Adams in 1896. He recognized five White River species: Leidy's two, Cope's one and two then described as new, *H. robustus* and *H. insolens*. He noted the unquestionable synonymy of *Dinotomius* with *Hoplophoneus* and placed *Dinotomius atrox* in the synonymy of *H. occidentalis*. This synonymy was accepted by Riggs (1896) in his detailed description of Williston's material and was also accepted by Williston, himself, and by all later students. The only valid characters used by Adams to define the five species were those of size. He also mentioned differences in the vertical or overhanging character of the occiput, but later study has shown that these differences, as far as real and not due to distortion, are simple functions of size. Adams also mentioned the presence or absence of P³, but showed it to be variable and later students have found that it is not clearly associated with size or other characters and has no evident taxonomic value. Of *H. occidentalis* he added that it had no posterointernal cusp on the lower sectorial. Riggs (1896) noted that this was an error as regards "*D. atrox*" and that it might validate that species if confirmed in *H. occidentalis*. In fact this part of the tooth is broken away in both the other specimens known to Adams and the supposed character was simply a mistake.

Drepanodon had previously been used at least once in a different sense and that *Hoplophoneus* is the valid name of the genus here under discussion.

¹ Scott and Jepsen (1936) believed that Leidy's was the first use of this generic name and that he therefore validated it as antedating *Hoplophoneus* in this sense. They have since found (pers. com.) that

In 1920 Thorpe studied the group and added three more species, *H. latidens*, *H. marshi*, and *H. molossus*. These are all well within the size range of the previously named species and were defined mainly on the basis of various supposedly distinctive proportions and indices in the type skulls and jaws.

The species so far mentioned were all from the lower Brulé or its equivalent. Some later forms (John Day) were referred, but these seem best placed in different genera and are not discussed here. The first *Hoplophoneus* found in the older Chadron was *H. mentalis*, described by Sinclair in 1921, and in 1926 Jepsen named another Chadron species, *H. oharrai*. This completed the list of supposed species of (Oligocene) *Hoplophoneus* so far proposed, which thus includes:

- 1.—*H. primaevus* (Leidy, 1851).
- 2.—*H. occidentalis* (Leidy, 1869).
- 3.—*H. oreodontis* (Cope, 1873).
- 4.—*H. atrox* (Williston, 1895).
- 5.—*H. robustus* Adams, 1896.
- 6.—*H. insolens* Adams, 1896.
- 7.—*H. latidens* Thorpe, 1920.
- 8.—*H. marshi* Thorpe, 1920.
- 9.—*H. molossus* Thorpe, 1920.
- 10.—*H. mentalis* Sinclair, 1921.
- 11.—*H. oharrai* Jepsen, 1926.

Sinclair (1924) expressed dissatisfaction with the large number of supposed species, most of them apparently living in the same region at the same time, and showed that most of these supposed species intergraded and that they did not differ more than do individuals of one species of living cats. He explicitly reduced *H. latidens* to the synonymy of *H. primaevus* but otherwise made no attempt at revision. Jepsen (1933) again emphasized the difficulty of specific definition in a thoughtful, pessimistic digression on the unsuitability of Linnacan taxonomy for paleontological use. He was then studying *Eusmilus* and did not discuss the species of *Hoplophoneus* except to say that too many species were currently recognized.

In their description of the genus, Scott and Jepsen (1936) did not attempt specific revision, but said that the number of proposed species was assuredly too large. They did list *H. robustus*, *insolens*, and *atrox* as synonyms of *H. occidentalis*, without discussion, and omitted mention of *H. latidens* and *marshi*.¹ The other proposed species were listed as if valid and *H. oreodontis*, *primaevus*, *occidentalis*, and *oharrai* were said to be "most distinctly marked as separate."

SIZE DISTRIBUTION AND VARIATION IN THE *H. OREODONTIS-INSOLENS* SERIES

The first step in attempting the determination of probable true specific limits is to bring together as large and as homogeneous a sample as possible. For this purpose specimens from the lower Brulé of the Big Badlands of South Dakota referred or referable to *H. oreodontis*, *H. primaevus*, *H. robustus*, and *H. insolens*, as these species have hitherto been distinguished, afford the best available basis for study. These form a nearly continuous sequence in size. The still larger *H. occidentalis* proved, in the course of this analysis, to be distinctly separable from this series and so is omitted from the analysis given here and is discussed on a later page. The type and two important referred specimens of *H. oreodontis* are likewise omitted here because, as will be shown later, they are not in growth

stages comparable with the other specimens in question and because the type and one of the referred specimens are not from South Dakota. Adult specimens from South Dakota referred to *H. oreodontis* are, however, included in the present section. Thorpe's three species are omitted from this basic sample for comparison, because they are not from South Dakota and because they are defined mainly by characters of proportion requiring separate discussion. *H. mentalis* and *oharrai* are from lower horizons and are therefore also kept separate.

The area covered by these specifications

¹ It is probably a *lapsus* that they gave a copy of Thorpe's figure of the type of *H. latidens* over the legend "*Drepanodon molossus*" (their Fig. 7). This skull does not show the characters that they give as distinctive of *H. molossus* and so they probably did not mean to reduce *H. latidens* to the synonymy of the latter.

OBSERVED RANGES IN LOWER BRULÉ ADULT SPECIMENS OF *Hoplophoneus* FROM SOUTH DAKOTA, EXCEPT *H. occidentalis*

Variate	<i>H.</i> " <i>oreodontis</i> "		<i>H.</i> " <i>primaevus</i> "		<i>H.</i> " <i>robustus</i> "		<i>H.</i> " <i>insolens</i> "		Totals	
	N	R	N	R	N	R	N	R	N	R
Prosthion—basion	3	130 $\frac{1}{2}$ –137	8	142–156	5	163–179	2	177–179	18	130 $\frac{1}{2}$ –179
Prosthion—inion ¹	3	144–163	1	169	5	184–200	2	206–216	11	144–216
Prosthion—anterior edge of P ⁴	3	36–41	6	41–47	7	49–55	2	51–55	18	36–55
Maximum diameter of upper canine alveolus	3	11.7–13.9	9	13.6–15.2	6	14–18.5	1	17.5	19	11.7–17.5
P ⁴ –M ¹	2	29.6–30.5	10	30.5–37.5	7	34.5–41.5	2	37.3–43.5	21	29.6–43.5
Length P ³	3	9.7–10.1	9	9.8–12	6	11–12.8	2	12–14	20	9.7–14
Length P ⁴	2	17.3–17.6	9	17.7–20.9	7	17.5–21.5	2	20.5–21.3	20	17.3–21.5
Palatal length	3	62–75	8	72–77	7	78–90	2	86	20	62–86
Breadth on post-orbital processes	2	56–57 $\frac{1}{2}$	4	63–70	4	67–76	2	76–81	12	56–81
Breadth of post-orbital constriction	2	28	8	23–34	5	31–36	2	35–36	17	23–36
Diastema, C–P ³	1	11.5	7	11.5–14.5	4	13–16.3	0		12	11.5–16.3
Condylobasal length	2	135–145	6	149–165	4	172–182	1	190	13	135–190
Orbit to alveolar margin	1	23	5	21 $\frac{1}{2}$ –26	3	23–26 $\frac{1}{2}$	0		9	21 $\frac{1}{2}$ –26 $\frac{1}{2}$
Infraorbital foramen to posterior edge of zygomatic process of maxilla	1	21	5	22–27	3	25 $\frac{1}{2}$ –29 $\frac{1}{2}$	0		9	21–29 $\frac{1}{2}$
Length of face	1	47	5	47–58	5	53–58	1	67	12	47–67
Length of cranium ²	1	98	4	102–105	4	111–125	1	123	10	98–123
Length of mandibular ramus	2	106–112	5	110–123	6	130–137	1	142	14	106–142
Depth of flange	1	38	4	39–47	5	41–50	1	57	11	38–57
Diastema C–P ⁴	2	28–29	5	29–37	5	34–39	1	39 $\frac{1}{2}$	13	28–39 $\frac{1}{2}$
Depth under P ⁴	2	19.4–21.5	5	20–24	5	23–26.6	1	26.2	13	19.4–26.6
Depth posterior to M ₁	2	20–20.6	5	18–21	5	21.5–26	1	24.6	13	18–26
Coronoid height above condylar-alveolar level	2	17–19 $\frac{1}{2}$	4	16 $\frac{1}{2}$ –20	4	15–20	1	17 $\frac{1}{2}$	11	15–20
Length P ₁	2	9–11.4	5	11–12.8	6	11–13.5	0		13	9–13.5
Length M ₁	2	15.7–16	5	15–18	6	15.8–20.0	0		13	15–20

is only about 200 square miles, incomparably smaller than the average range of a single species of cats today and, indeed, far smaller than the average for a single subspecies or geographic race.³ It is prac-

¹ Or, maximum diameter of skull.

² The skull is taken in lateral projection, a line drawn from prosthion to most distant point of condyle and a vertical dropped to it from the most anterior point of the orbital rim. The length anterior to this vertical is the facial length and that posterior to it the cranial length. The measurement is difficult and subject to observational error, but it provides important data not as well shown by any other dimensions.

³ For instance, a single species of jaguar, perhaps the most nearly comparable of recent American cats, ranges over more than five million square miles and its local races, even in the most split classification, average over three hundred thousand square miles

tically impossible that any geographic varieties were developed in such an area, and unlikely that any would be preserved in it. It is quite possible that different allied taxonomic groups might have occurred in different ecologic stations in the area, but this can only be inferred from the existence of such groups, not used as a basis for their separation and recognition.

The geologic time covered by the lower Brulé is considerable, since a thickness of as much as four hundred feet of sediments is

apiece. Figures for the puma are still larger, and those for the medium-sized to large Old World cats have the same order of magnitude.

included. *A priori* there is no reason why distinct species may not have followed each other here at different times. In fact, however, there is now no evidence that this did occur and some evidence that it did not. All four of the supposed species here considered (and also *H. occidentalis*) have definitely been recorded within a vertical distance of less than forty feet of conformable strata and all the data suggest that they were absolutely contemporaneous. It is fairly well established that a succession of invading, sharply distinct species does not occur. It is probable that slow evolution *in situ* did occur, but if so the known facts almost preclude evolution of more than subspecific rank. This would be shown only by a secular shift in group means, and the material for its possible detection is not now in hand.

Twenty-eight different continuous variates of skull and jaws have been studied in detail. By combining trustworthy measurements in the literature (particularly Sinclair, 1924, and Jepsen, 1933) with others taken by myself and with one set (on the type of *H. robustus*) kindly taken for me by Dr. C. L. Gazin, I have been able to obtain from nine to twenty-one individual values for each of these variates. The fact that measurements have been taken by different hands introduces another element of variation, but this is clearly too insignificant to have affected materially the results based on these data. Some variates, such as breadth across the zygomata, were discarded because the material afforded too few reliable values, and others, like the distance from prosthion to bregma, were given little emphasis because they proved to have little practical significance or not to be comparable in different instances.¹

The preceding table gives the observed ranges for most of the important variates considered. The "specific" determinations

follow either those published by competent authorities who recognized the four species as separate or were made by me using their criteria. It will later appear that they probably do not correspond with true taxonomic species.

These observed ranges give the most immediately comprehensible picture of the general situation for a practical worker. For the present purpose, however, they are of less value than are actual distributions, to be studied for evidences of bimodal or multimodal character, and statistical data providing valid means of comparison of the relative amounts of variation of each variate.

Of the various distributions, some have no very clear mode, some have one, some seem obscurely to have two, and some clearly have two. It would take many pages and it is not necessary to give all these in full. The following examples cover the sorts of patterns shown:

A.—Breadth at postorbital constriction
(Mode obscure)

Value	Frequencies				All
	<i>H.</i> "oreo- don- tis"	<i>H.</i> "pri- mae- vus"	<i>H.</i> "ro- bus- tus"	<i>H.</i> "an- sol- ens"	
23.0-24.9		1 ^a			1
25.0-26.9					0
27.0-28.9	2	1			3
29.0-30.9		1			1
31.0-32.9		3	2		5
33.0-34.9		2	2		4
35.0-36.9			1	2	3
					17

B.—P³-M¹
(One well-defined mode)

Value	Frequencies				All
	<i>H.</i> "o."	<i>H.</i> "p."	<i>H.</i> "r."	<i>H.</i> "t."	
28.0-29.9	1				1
30.0-31.9	1	2			3
32.0-33.9		3			3
34.0-35.9		4	3		7
36.0-37.9		1	2	1	4
38.0-39.9			1		1
40.0-41.9			1		1
42.0-43.9				1	1
					21

¹ The bregma, for instance, is the intersection of sagittal and coronal sutures. Its position is subject to great non-significant variation from unimportant fluctuations of these sutures. Moreover in adult specimens the coronal suture frequently cannot be exactly followed. In young individuals it crosses the midline near or at the anterior end of the sagittal crest, but in old individuals it is commonly at some distance—and usually an indeterminable distance—posterior to this point.

^a This remarkably small value, from Sinclair, may possibly be a misprint, although it is not definitely beyond the possible range. In either case it makes no important change in the general situation.

C.—Condylobasal length
(Two obscure modes)

Value	Frequencies				All
	H. "o."	H. "p."	H. "r."	H. "i."	
135-144	1				1
145-154	1	4			5
155-164		1			1
165-174		1	2		3
175-184			2		2
185-194				1	1
					13

D.—Length of mandibular ramus
(Two well-defined modes)

Value	Frequencies				All
	H. "o."	H. "p."	H. "r."	H. "i."	
105-109	1				1
110-114	1	1			2
115-119		3			3
120-124		1			1
125-129					0
130-134			1		1
135-139			4		4
140-144				1	1
					13

Comparison of these and of other distributions of linear dimensions (and also those of proportions and qualitative characters, studied with equal care) show the following facts beyond much question:

1.—The adult specimens referred to *H. oreodontis* are in no way clearly distinguished from the *H. primaevus* group, and they appear to be merely the two or three smallest individuals of *H. primaevus*.

2.—The specimens placed in *H. insolens* are similarly indistinguishable from the general sample identified as *H. robustus* and probably are merely the largest individuals of the latter.

3.—The *H. oreodontis-primaevus* group and the *H. robustus-insolens* group approach each other closely in all characters and their ranges widely overlap in many characters (including all tooth dimensions).

4.—These two groups tend, nevertheless, to have distinctly different modes in many characters, especially longitudinal bone dimensions (and in proportions or indices that can be shown to be correlated with these), and by comparing all of these and the positions of individual specimens in the different distributions it is possible to divide the whole series into these two groups, leaving only one or two specimens of somewhat doubtful position.

There are thus two, but not four, different groups included in this series of specimens. The next thing to consider is what these groups are in biologic and tax-

onomic terms. I think that they are simply the males and females of the same species, on the following grounds:

1.—From the field data it appears that these two groups lived for a considerable period in the same region at the same time. They are commonly found in close association. It is almost impossible for two species so closely similar in all characters, actually intergrading in most, to remain distinct when occupying the same area.

2.—The two groups are about equally abundant, such discrepancy in numbers as exists in collections being far within the probable limits for chance sampling of a population in which they did occur in equal numbers. Male and female cats of one species tend to be about equally abundant. When two distinct cat species occupy one area, one is generally much more abundant than the other in collections.

3.—The differences between the two groups are closely similar in kind and in degree to those between males and females of one species of cat in populations where the sex difference is known. They do not correspond, or are not so closely analogous, to differences usually existing between two species of cats occupying one area.¹

4.—If these are distinct species, then one or both of these two groups presumably contains both males and females.² But if this were true, it would follow that these two species would show less sexual dimorphism and less variation within the species (sexes combined) than is yet known for homologous characters of any species of felids, recent or fossil.

These considerations are in themselves almost conclusive. In order to test whether the amount of variation shown by this species, on the hypothesis here expressed, is consistent with that normal for a single species of cats, I have compiled and analyzed a large number of data on recent lions, leopards, jaguars, and pumas and on the extinct species *Smilodon californicus* and *Panthera atrox*. The results show conclusively that the amount of variation shown by the whole *H. oreodontis-primaevus-robustus-insolens* series is of the same order of magnitude as in most single species of cats. It is, if anything, rather less than might be expected. These extensive and complex data are not here published in full. The following extract from

¹ These statements are based on detailed study of many data on several species of recent and some of fossil cats.

² My records include about a dozen members of each group. The chances that each group would be all of one sex and yet that the two should not be the two sexes of one species are so small as to be quite negligible.

COMPARISON OF VARIABILITY IN *Hoplophoneus primaevus* (INCLUDING *H. oreodontis*, *H. robustus*, AND *H. insolens*) WITH TWO OTHER FELID SPECIES

	N	R	M	σ	V
1.—Condylobasal length of skull:					
a.—Mixed samples:					
<i>H. primaevus</i>	13	135-190	162.3 \pm 4.4	15.9 \pm 3.1	9.8 \pm 1.9
<i>Smilodon californicus</i>	25	271-344	308.6 \pm 4.7	23.4 \pm 3.3	7.6 \pm 1.1
<i>Panthera pardus chui</i>	8	179-245	206.0 \pm 9.1	25.7 \pm 6.4	12.5 \pm 3.1
b.—Males only:					
<i>H. primaevus</i>	6	165-190	177.5 \pm 3.3	8.1 \pm 2.3	4.6 \pm 1.3
<i>P. p. chui</i>	13	206-245	221.8 \pm 3.7	13.5 \pm 2.6	6.1 \pm 1.2
c.—Females only:					
<i>H. primaevus</i>	7	135-157	149.4 \pm 2.6	6.9 \pm 1.8	4.6 \pm 1.2
2.—Length P ⁴					
a.—Mixed samples:					
<i>H. primaevus</i>	20	17.3-21.5	19.53 \pm .30	1.34 \pm .21	6.9 \pm 1.1
<i>Smilodon californicus</i>	22	33.4-46.0	40.15 \pm .53	2.47 \pm .37	6.1 \pm .9
<i>Panthera pardus chui</i>	8	22.4-27.9	25.19 \pm .64	1.82 \pm .45	7.2 \pm 1.8
b.—Males only:					
<i>H. primaevus</i>	9	19.0-21.5	20.43 \pm .27	.82 \pm .19	4.0 \pm .9
<i>P. p. chui</i>	13	24.5-27.9	25.86 \pm .30	1.07 \pm .21	4.1 \pm .8
c.—Females only:					
<i>H. primaevus</i>	11	17.3-20.9	18.78 \pm .37	1.23 \pm .26	6.6 \pm 1.4

them is sufficiently typical of the whole, using one variate (skull length) in which sexual dimorphism is likely to be pronounced and one (length of upper carnassial) in which it is usually more obscure. The *H. primaevus* sample has been sexed as explained above, considering *H. "oreodontis"* and most *H. "primaevus"* (of authors) as females, and one *H. "primaevus"* (which according to its combined characters should probably have been identified as a small "*robustus*") and *H. "robustus"* and *H. "insolens"* as males.

The *Smilodon californicus* sample is that of Merriam and Stock (1932). It is, on the whole, less variable than would be expected—there are several possible reasons for this, but it is not here important because, little variable as it is, the difference from the whole *Hoplophoneus* sample is not probably significant. The *Panthera pardus chui* sample comprises seventeen adult specimens from the Belgian Congo, classified and annotated by Allen (1924). On these and nineteen other recent leopard skulls and associated jaws, I have made all the measurements homologous with those

made on *Hoplophoneus*.¹ On the whole this recent group is actually more variable than the combined *Hoplophoneus* sample, although one would expect the greater heterogeneity and the varying preservation of the fossils to exaggerate their variability. The *P. p. chui* sample is very homogeneous, all belonging not merely to one species but also to one local, interbreeding geographic race living under almost completely uniform ecologic conditions. This leopard sample happens to include only four adult females and in order to test the hypothesis as to *H. primaevus* here advanced, a sample balanced as to sex was made by combining these with four males taken at random (by shuffling and drawing numbered cards) from the full series of thirteen adult males.

It is interesting that the pronounced dimorphism of most of the larger felids has

smaller and darker, and to differ in various proportions. They were therefore distinguished as a subspecies. The procedure is, of course, entirely correct, but the series are highly variable and the mean differences are so slight that they are not statistically significant in any case. These series of specimens, which include all of Allen's hypodigm of both species and the type of *P. p. iturensis*, thus do not demonstrate that the forest population is really distinct. A larger series might show this or might obliterate the supposed difference. Incidentally, Allen exaggerated the difference by discarding the smallest old male of *P. p. chui* on the grounds that it is a dwarf. The specimen is not abnormal as far as any objective data show and is merely a normal small variant. His largest specimens of this series could with equal propriety have been discarded as "giants" making *P. p. iturensis* obviously the same as *chui*. Even his smallest *iturensis* adults are well within the probable range of *chui* as far as his material shows.

¹ An accidental result of the study of variation in the Congo leopards was to show that the supposed subspecies *Panthera pardus iturensis* J. A. Allen, 1924, is not demonstrably distinct from *P. p. chui* (Heller, 1913). Allen sorted his specimens by habitat into those of the rain forest (Ituri) and those of the adjacent savannah and brush country. The latter were referred to *chui* and the former were found to be

related forms, were studied carefully and several others more summarily examined. The observed ranges of ten indices for the supposed species *H. oreodontis*, *primaevus*, *robustus*, and *insolens* are given in the accompanying table. (In each case the index is understood to be 100 times the ratio as labeled.)

It is evident that all these indices are highly variable and also that no one (or indeed no combination) of them would suffice to classify an individual specimen as belonging to one and only one of these supposed species or even to place it surely as male or female, assuming that the four "species" really represent two sexes of one species as concluded in the previous section. This is good confirmatory evidence that these specimens do really belong to one species. Groupings based on size, as these "species" were, cannot also be defined by proportions and groupings based on proportions cannot also be defined by size. In most cases there are no significant differences in indices between the various size groups and the group of which the most observations happen to be available often shows nearly or quite the whole observed range for all.

There are, however, indices for which there is a fairly regular change in the averages for smaller and for larger individuals, even though the great variation and the overlapping ranges make this obscure or undeterminable on the basis of a few specimens. For instance, index D of this list is really and definitely smaller for *H. "insolens"* (or for large males) than for *H. "oreodontis"* (or small females). Such changes may have taxonomic value or they may be correlated with size regardless of taxonomic differences. It is now a well established fact that proportions change during growth and that they may be correlated with size, even among adults, in such a way as to be determined by the size and not to be independent genetic characters. Thus a difference in index accompanied by a difference in size has no taxonomic significance unless it can be shown to be different in kind or degree from what normally occurs in a single species of the group under consideration.

To check this, the relations of proportions to size in *Hoplophoneus* have been examined in some detail and compared with growth changes in *Hoplophoneus* and with growth series and adult series in *Smilodon californicus*, *Panthera atrox*, *Panthera onca*, and *Panthera pardus*. Phleger (1940) in an important paper on this subject, has studied relative growth involved in several analogous indices of the first three of these species. For a rough determination of relative growth in *Hoplophoneus*, Amer. Mus. No. 9764, an immature animal with the permanent dentition just starting to be used, was compared with old individuals of comparable size as judged by the cheek teeth. From all these data the following conclusions were reached as to each of these ten indices:

A.—These two dimensions are closely correlated as would be expected from their close structural relationship and in all the series examined their index has relatively little variation, with no evidence of significant trend of change with growth or adult size. In *Hoplophoneus* one of the largest specimens happens to have the largest index, but this is probably a chance result. The series as a whole shows no significant correlation of this index with size or other characters.

B.—The facial: cranial index is highly variable but in *Panthera pardus* (both *chui* and the perhaps synonymous *itrensis*) there is a slight but real tendency for the index to increase with age and with size. This is, moreover, a widespread tendency among mammals (and even among many lower vertebrates). The face grows more rapidly than the cranium, so that older and larger animals have relatively longer faces. The young A.M. No. 9764 also has a slightly shorter face, relative to the cranium, than do the most nearly comparable adults. In the adult specimens the correlation is obscured by great variation and it is not statistically significant for the small available series of values (ten), but the visible trend is in the same direction. Its relatively short face has been given as a distinctive character of *H. "oreodontis"*, but in the first place the index is within the wide range of variation

for the larger supposed species, and in the second place the fact that it is below the average for the larger forms is just what would be expected within a single species.

C.—This index shows no clearly significant trend in any of the material examined. It is not correlated with size, as far as can be seen from small samples, and it fluctuates erratically. It is the resultant of two opposite factors and the ascendancy of one over the other is not definite or predictable. The general width of this part of the skull increases much more slowly than does the skull length, but on the other hand in middle stages of growth, at least, there is an acceleration of the development of the postorbital processes themselves since these are barely developed in young and small individuals and are prominent in old and large ones.

D.—In spite of the erratic overlap of the observed ranges, this index in every felid examined shows a strong, indubitably significant negative correlation with the gross size of the skull, or in other words the breadth of the postorbital construction has strong negative heterogony. Phleger found values of the heterogony coefficient, k , of .42 for *Panthera onca*, .55 for *Smilodon californicus*, and .56 for *Panthera atrox*. Between our immature *Hoplophoneus*, A.M. No. 9764, and the type of *H. robustus* k is .41 and between this immature animal and the likewise comparable Princeton No. 12957 k is .45. Larger growth series of *Panthera pardus* show that the interorbital breadth grows almost harmoniously for a short time after birth but that by the time the full deciduous dentition is well in use its growth slows down abruptly and that it thereafter grows very slowly or hardly at all. The same tendency has been observed in other mammals and it is probably general.

E.—The size of the canine tends to be positively, but only loosely, correlated with adult size. It would be expected to show strong negative heterogony with growth, on the principle that the canine does not, in fact, grow while the skull does. It is surprising that such a tendency is not really visible in our material of *Hoplophoneus*. Between Amer. Mus. No. 9764,

for instance, and comparable adults k is not significantly different from 1.0, which would imply either that the canine grows harmoniously with the skull or that this animal is not really comparable but belongs to a group with decidedly smaller canines. Even among the mature specimens the differences are not what would be expected and what occur with other tooth indices. The material of various growth stages is insufficient to explain the anomaly, but it suggests the possibility that the canine alveolus (which is what is measured, rather than positively homologous points on the canine itself) does indeed grow in this group. The canine perhaps continues to move downward for some time during adult life, so that the part at the alveolus changes and becomes progressively larger.

This peculiar situation, whatever its true cause, tends to obscure real and definitive differences between the size of the canine in different mature groups of *Hoplophoneus*. Thus young males may tend to have relatively smaller canines (or at least canine alveoli) than old females. There is, nevertheless, some difference, the average index (E) for five specimens regarded as males being 10.3 while for nine regarded as females it is 10.0, but this is a somewhat smaller difference than is usual in cats and is not clearly significant. Taking only individuals in late maturity or senility, in which further protrusion of canines is unlikely, would probably give higher averages for both males and females and probably show a greater mean difference between them, but I have only one probable male specimen in this condition (which does happen to have a very high index, 11.1). These data are consistent with the sexing of *Hoplophoneus* specimens as I have carried this out, but they do not strongly confirm its correctness or help in its performance.¹

F.—The length of P^4 , measured on the tooth itself, certainly does not grow significantly after eruption. Its index against

¹ Even in recent cats that show very strong sex dimorphism and decidedly different averages for this index in the two sexes, the ranges for the index often overlap so that sex cannot be surely determined from the index itself.

skull length therefore becomes rapidly smaller as the individuals become larger in a growth series, and the same decisively significant negative correlation with skull size is shown within the adult series not only in these *Hoplophoneus* specimens but also in *Panthera atrox* and *P. pardus*, in which I have measured the correlation, and probably in all cats. In these animals males and females and small and large individuals of the same sex differ less in the size of the cheek teeth than they do in skull dimensions. The situation in this *Hoplophoneus* series is what would be expected by analogy in a single species.

G.—The index for relative depth of flange, although highly variable, shows no evident trend in our material. As far as shown, the flange has great individual variation but grows more or less in harmony with the growth of the skull. This again suggests that the upper canine grows (or is progressively more protruded) throughout much of the animal's life, for the canine tip never projects beyond the flange and yet the flange is not relatively longer in young than in old animals.

H.—Contrary to expectation, this index shows a low, suggestive but not conclusive, negative correlation with length of ramus. There may thus be a tendency for larger animals to have relatively more slender jaws, although this is too variable to be certain on the basis of a small series of animals. *P. pardus* seems to show the same tendency, but here again the evidence is not fully conclusive.

I.—This index shows a statistically significant negative correlation with length of mandible. As in all cases, there is much variation, but large individuals of *Hoplophoneus* unquestionably tend to have relatively smaller coronoid processes. This may also be in part a sexual difference since the difference between presumable males and females may (doubtfully) be a little more pronounced than would be expected from size alone. Although it was not primarily used for that purpose, the index permits sexing most specimens, an index (for an adult) greater than 15 usually belonging to a female and one less than 14.5 usually to a male. The distributions

do overlap between these two values. The same tendency for large individuals to have relatively small coronoid processes is seen in *Smilodon californicus* but I do not detect it in *Panthera*. It is probably related to the great difference in jaw musculature between the machairodont and feline groups.

J.—This index is analogous with F and the remarks about the latter are also true of this.

Thorpe (1920) has used an index for the relationship of the anteroposterior dimension of the anterior zygomatic pedicle (from infraorbital foramen to posterior margin of the zygomatic process of the maxilla) to its vertical dimension (from the orbital rim to the alveolar margin). He says that this has considerable value in specific determination and uses it in defining *H. latidens*, said to have an index of 117 as against 162.5 for *H. robustus*¹ and 143 for *H. primaevus*. This implies that the index is relatively invariable within one species and is positively associated with other characters of possible taxonomic value, but grounds for these assumptions are not given. I have investigated the point in fourteen specimens of *Hoplophoneus* and in twenty-two of *Panthera*. The index is highly variable within any one species (no matter how narrow the species be made, beyond placing every specimen in a distinct species) and it does not show evident association with any other possibly significant characters. Thus for specimens referred by competent authorities (including Thorpe, himself) to *H. primaevus* and surely referable to that species even if *H. oreodontis*, *H. robustus*, etc., be kept distinct, the index varies in known specimens from 88.5 to 143. Instead of being distinctive in this respect, the type of *H. latidens* happens, by accident, to be almost exactly at the average for *H. primaevus*.

Nor is there in my data any clear trend or association of the values of this index, even in the loose way that the facial-cranial index is associated with size. It is possible that the index tends to become smaller

¹ But there is a *lapsus* somewhere, because the dimensions that he gives would make the index 180.5, which is so much above other known indices as to be improbable. Even 162.5 is the highest known to me, although not outside the probable range.

with increasing size (or age), but if so the correlation is very low and many more specimens would be required to demonstrate its reality (i.e., statistical significance). As it is, the four smallest specimens for which I have data cover almost the entire known range for the genus, from 91 to 150. Their mean value, 120, happens to be greater than the mean for the four largest specimens, 103, but this could be a mere accident of sampling. Even if real, its taxonomic value would be more than doubtful, for the differences bear no relationship to the supposed species as determined by Adams, Thorpe, etc. For instance, the types of *latidens* and *molossus* and authoritatively identified, thoroughly representative specimens of *robustus*, *primaevus*, and *oreodontis* all show indices within the relatively narrow range 108-120. Moreover, indices in Pleistocene *Smilodon* and even in recent leopards also occur in this range. The index seems to have less taxonomic value than almost any other.

This is not said in criticism of Thorpe, but to emphasize a serious defect in most paleontological taxonomy, including much of my own. We often tacitly assume that any great, clear morphological distinction has taxonomic value. In fact, as this example shows and as could be shown by many more examples, this principle is thoroughly fallacious. A very slight morphological difference may have taxonomic value and a very great difference may have none. The valid criterion is not the greatness of the distinction, but its association with different samples defined on other grounds, taking into account some good

measure of the variability of the character.

The sizes and proportions of limb bones and other skeletal parts have not been studied in great detail. Although it is the rule rather than the exception for skulls of *Hoplophoneus* to be associated with skeletal material, the number of homologous post-cranial measurements available to me is not great enough to establish surely the significance of deviations and the trends of associations. It is, however, evident that the general size grouping is consistent with that of the skulls and can be interpreted in the same way. The characters sometimes considered of taxonomic value are those of length of limb bones relative to the skull and of the stoutness of the bones relative to length. In recent cats (and indeed in most mammals) these are both correlated with size within a species. Small individuals tend to have relatively more slender limb bones but these bones tend to be shorter relative to the skull, i.e., their width grows with positive heterogony relative to their length and the length with positive heterogony relative to the skull. What data are available for *Hoplophoneus* simply agree with this general trend and suggest no basis for specific distinction. For instance, in the smaller specimen Princeton No. 13628, referred to *H. "oreodontis,"* the index of distal width against length of femur is 17 and that of length of femur against condylobasal skull length is 113. In the larger Amer. Mus. No. 1406, referred by Matthew to *H. "robustus"* and by Scott and Jepsen to *H. "primaevus,"*¹ both indices are larger, as would be predicted, 22 and 118, respectively.

QUALITATIVE CHARACTERS

The only clear-cut qualitative differences observed within *Hoplophoneus* are the presence or absence of P^2 and of I_1 . Although Adams suggested that the presence of P^2 had some significance, he showed that it was variable and later students have not given it taxonomic value. It is more often present than not, but its absence has no clear association with size or other possible taxonomic characters, or even, apparently,

with age since P^2 happens to be quite absent in one of the rare immature specimens and to be present in our most nearly senile individual. In specimens referred to each of the four supposed species here under consideration P^2 is present in some and

¹ This is the specimen referred to in the first column of their table, 1936, p. 139. The number given there, 1405, is a misprint and should be 1406. I believe that this animal is a male.

absent in others. Moreover, in specimens referred to *H. primaevus* (*sensu stricto*) and to *H. robustus*, at least, it is present on one side and absent on the other. It also varies greatly in size and in position, sometimes a fairly large, two-rooted tooth, sometimes a one-rooted vestige, sometimes near the canine, and sometimes almost overlapping P^3 .

Amer. Mus. No. 9764, an immature individual placed by Matthew in *H. oreodontis*, appears to have only two incisors. As regards the upper jaw (Matthew, 1910, Fig. 3A), this is an error. The side figured is restored, and further preparation and study of the other side shows three incisor alveoli. In the lower jaw only two incisor roots are present but (a) I_1 has a short root in this genus and its alveolus is possibly

broken off in this specimen, (b) in some cats there is a stage of replacement when only two lower incisors are functioning and this is an immature animal, and (c) the otherwise very closely similar Amer. Mus. No. 5338 has three lower incisors and the most probable explanation of the present specimen is that it has an individual anomaly. Wood (1927) refers to the specimen and notes that I_1 may be absent in two known specimens of *H. mentalis*, but that this is somewhat doubtful as to fact and if true is of doubtful significance.

I_1 is relatively reduced in *Hoplophoneus* and there may have been some tendency toward its loss, but this is not established and has no present significance for taxonomy.

THE TYPES OF *H. ROBUSTUS* AND *H. INSOLENS*

Adams did not explicitly designate types of species and his descriptions, based on various specimens, are somewhat ambiguous in this respect. Although I believe both these species to be synonyms of *H. primaevus*, the designation of their types is important. Adams' description of *H. robustus* mentions Amer. Mus. No. 650 and Princeton No. 10647. He says that "the species is represented" by the latter but that the former, better specimen is "its most perfect type." Although he does not seem here to be using "type" in a technical sense, there is little doubt that Amer. Mus. No. 650 was essentially his type and it should be, and hereby is, designated lectotype if both of these specimens are considered syntypes. Dr. Matthew overlooked the fact that Amer. Mus. No. 650 was the type or the better syntype of *H. robustus* and he exchanged it with the U. S. National Museum, where it is now preserved.

Adams' description of *H. insolens* men-

tions three specimens and says that "either" (any?) of them are "typical": a skeleton determined by Osborn and Wortman as *H. occidentalis*, Princeton No. 11022, and Princeton No. 11372. Although not mentioned by number, either by Osborn and Wortman or by Adams, the first specimen mentioned is almost certainly Amer. Mus. No. 655. The three specimens are evidently syntypes in Adams' publication. Princeton No. 11372, which includes a good skull, appears to be the most exactly determinable specimen and is therefore designated as lectotype. There is some doubt whether Amer. Mus. No. 655 really belongs in the same group, but its skull is so poorly preserved that any conclusion based on it is shaky. The lectotype, as represented by measurements given by Jepsen (1933), is included in the preceding discussions of variation in the *H. primaevus* group. Amer. Mus. No. 655 is not, because it provides so few reliable measurements and is so uncertain in general.

H. OREODONTIS

The specimens discussed above and shown to be small females of *H. primaevus* do not include the type or two important referred specimens of *H. oreodontis*.

The type of this species, now Amer. Mus. No. 5337, is a fragment of the right lower jaw with two unerupted incisors, and with dm_4 in place. P_1 is forming in its crypt, but so little of it is yet calcified that its definitive form and size cannot be determined. Dm_4 , the most characteristic part of the specimen, is not known to me in any other specimen of *Hoplophoneus*.

Cope's emended, indeed totally different, definitive description of *H. oreodontis* in 1885 was not based on the type but on another specimen, now Amer. Mus. No. 5338, which includes the lower jaws and the facial part of the skull, with the permanent dentition. The hypodigm of the species as Cope left it (1885) and as subsequent students have accepted it thus in reality excludes the type and for Cope was essentially this one referred specimen. Adams practically ignored both the type and Cope's hypodigm and used as his stated basis for comparison, i.e., as his hypodigm, Princeton No. 10515. The same specimen was apparently Sinclair's hypodigm (1924). Jepsen (1933) gave measurements of this specimen and another, Princeton No. 13628, and these two seem to have been the principal if not the only members of the hypodigm of Scott and Jepsen (1936).

To these specimens may be added another, Amer. No. 9764, which includes almost complete skull and jaws and is closely comparable with Cope's second specimen, Amer. Mus. No. 5338. Matthew identified this specimen as *H. oreodontis* and apparently based his concept of the species mostly on it, although he did not say so in print. He figured the palate of this specimen (1910, Fig. 3A), but he labeled it simply *Hoplophoneus*, without specific name. His measurement on a later page (p. 313) was probably of this specimen. It has the peculiarity that only two incisors seem to be present, as discussed above.

If one goes back to Cope's type, then *H. oreodontis* is now unrecognizable and must

remain so until a series of specimens shows the specific association of dm_4 with the permanent dentition. The type does not warrant the conclusion that *H. oreodontis* is a small species, since its small size is purely juvenile.

It is extra-legal but is, I think, justified to accept Amer. Mus. No. 5338 as neotype of this species.¹ It was, Cope says, found at the same horizon and locality as the type, it cannot be shown to be of a different species, it was referred to this species by its original describer, and the definition that has ever since been accepted as actually basic for the species, even though it is not the earliest definition (which involved a thoroughgoing error), was based on this specimen and not on the type. If this is accepted as neotype, then the species can be shown beyond much doubt to be synonymous with *H. primaevus*.

It differs from representative specimens of *H. primaevus* as follows:

- All bone dimensions are absolutely smaller.
- The canine base or alveolus dimensions are absolutely smaller.
- The diastemata are also relatively smaller.
- The flange depth is smaller.
- The ramus depth is smaller.
- The ratios of cheek tooth dimensions to almost any bone dimension are larger.

If Amer. Mus. No. 9764 is considered to be the same as this specimen, whatever it may be—an almost unescapable conclusion—then the following can be added:

- The diameter of the postorbital constriction is relatively larger.
- The ratio of face to cranium length is smaller.
- The index of the anterior zygomatic pedicle is smaller.

This is an impressive array of characters and without analysis might appear to validate the species beyond any question, but it does not really do so. It is demonstrable that most of these characters of proportion are correlated with gross bone size among the cats in general and, with little doubt, in *Hoplophoneus* in particular, regardless of species. Smaller and larger specimens referred to *H. primaevus* by authorities who recognized *H. oreodontis* as distinct

¹ Using "neotype" broadly for any substitute type replacing either a lost type or, as in this case, a type that cannot be placed in any possible current hypodigm.

tend to show the same sort of differences, only less in the degree to which the size difference is less. Differences equal both in kind and in degree are demonstrated in a series of leopard skulls of a single local race.

It is necessary, then, either to show that these proportions are different from what they would be in a *H. primaevus* skull of THIS SIZE, or that the size itself is significantly different from *H. primaevus*. As far as one can extrapolate from the available specimens of *H. primaevus*, the proportions are within the probable range for that species at about this gross size. As for the size itself, Cope's 1885 hypodigm specimen or neotype and Amer. Mus. No. 9764 are the youngest specimens available (except the useless *H. oreodontis* type). Sutures closing or closed in all the other specimens are here completely open and the permanent teeth have just come into place and are barely beginning to wear. These are therefore small animals because they are young.

What size they would have when fully grown can best be judged from the only dimensions available on them that are not positively correlated with age, i.e., tooth dimensions. The table below affords a summary comparison.

Thus the cheek teeth are not only within the range of *H. primaevus*, *sensu stricto*, but are on the whole rather large for that "species" and are also within the range of (the probably synonymous) *H. "robustus"*. On this basis there is every reason to believe that these specimens far from representing a separate, small species would, if they had lived to full maturity, have been rather large individuals of *H. "primaevus"* or rather small individuals of *H. "robustus"*.

The canines are the only apparent argument against this conclusion. It is possible that they are really smaller than in most specimens of *H. primaevus*, and in such a case this could and, on the available data, probably would be merely a variation. There is, however, inconclusive but probable evidence that in *Hoplophoneus* the canines continued to move downward and hence that their alveoli continued to enlarge for some time after the permanent cheek teeth were in place. In that case, the small diameters of these alveoli are also simply characters of youth. In either case no reliable specific difference from *H. primaevus* is demonstrated.

There are specimens in the collections that as adults are distinctly below the size usually assigned to *H. primaevus* and that have been called *H. oreodontis*. These include Princeton Nos. 13628 and 10515 (Scott and Jepsen hypodigm of *H. oreodontis*) and our new specimen Amer. Mus. No. 38980, which is one of the oldest but one of the smallest specimens in the series. Combining my measurements with Jepsen's, the tooth dimensions homologous with those given below are for this group of three specimens:

LC	11.7-14.3
P ⁴ -M ¹	29.6-30.5
LP ³	9.7-10.2
LP ⁴	17.3-18
LP ₄	ca. 9-11.4
LM ₁	15.7-ca. 16

These specimens thus are really small, and not merely young. These are the specimens that I have considered to be small females of *H. primaevus*. The present data show that even if they are assigned to a distinct species, that species is not *H. oreodontis*.

	Amer. Mus. No. 5338	Amer. Mus. No. 9764	Referred to <i>H. primaevus</i> by Matthew and by Jepsen	Referred to <i>H. robustus</i> by Matthew and by Jepsen (including type)
LC	12 1/2	12	13.6-16.4	14-18.7
P ⁴ -M ¹		33 3	31.6-35.7	33.6-41.5
LP ³		11	9.8-12	11-13
LP ⁴	{ r. 20.2 l. 19.8	{ 19.7 19.7	18.2-19.9	17.5-21.5
LP ₄	{ r. 11.7 l. 11.9	{ 12.2 12.0	11-12.8	11-13.5
LM ₁	{ r. 17.7 l. 17.8	{ 17.9 17.7	16.1-18	15.8-20.0

H. MARSHI

Thorpe pointed out that this species is based on a submature individual and he compared it chiefly with *H. oreodontis* (i.e., presumably with Amer. Mus. No. 5338, not the type), which is also submature. The various skull proportions are near those of *H. oreodontis* if based on this specimen, in other words, near those of immature *H. primaevus*. Thorpe's type is perhaps somewhat older than A.M. 5338 and a somewhat larger individual, i.e., a male that would be referred to "*H. robustus*" when fully grown. Three of the characters on which Thorpe mainly based the species appear to be within the ob-

served or safely inferable range of large individuals of the *H. primaevus-robustus* group: large incisive alveoli, long pointed palate, and large molar alveoli. The fourth, peculiar shape of canines, appears to me to be wholly due to the fact that they are only partly protruded and would be far larger and more recurved in a fully adult animal. We do not have enough growth stages to judge the systematic position of an immature animal with entire confidence, but I do not see any clear-cut character that would exclude this from being a robust young male of *H. primaevus*.

H. LATIDENS

Sinclair (1924, p. 113) has already remarked that he saw no reason for referring *H. latidens* elsewhere than to *H. primaevus*. With this I entirely agree. Thorpe was, of course, quite correct in saying that his specimen is on the whole nearest to *H. robustus*, with some more *primaevus*-like characters and some between the two. It was doubtless this apparently equivocal mingling of the characters of two supposed species that led Thorpe to create a third, but the two species of reference intergrade and are (in my opinion) synonymous, making a group

into which Thorpe's specimen fits as a normal member not peculiar in any important way. The numerous small differences in absolute dimensions and in proportions noted by Thorpe are all well within the ranges now demonstrated for *H. primaevus*. It is entirely possible that a form like this, being from a different locality (in Colorado) and possibly a somewhat different horizon from typical *H. primaevus*, really does represent a different race, but the two known specimens do not show this to be the case.

H. MOLOSSUS

This species was described by Thorpe on the basis of a single specimen from Nebraska. Most of the dimensions are within the observed range of *H. primaevus* (defining that species to include *H. "oreodontis"* and *H. robustus*) and all are within the theoretical range (i.e., the range that the available sample shows to be probable for the whole population). Nevertheless the proportions are peculiar and are probably not those normal for *H. primaevus*, *sensu lato*. In general the bone dimensions of skull and jaws are small, about those of small females of *H. primaevus* (or of *H. "oreodontis"*) while the tooth dimensions are large, about those of aver-

age males of *H. primaevus* (or of *H. "robustus"*). This at once suggests that the animal is an immature male and some of its apparently distinctive indices are in fact closely approached by those of Amer. Mus. No. 9764 which is very probably an immature male of *H. primaevus*, but others are not and Thorpe's data plainly show that his type is not really immature. The facial:cranial index (B of the preceding discussion) has an observed range of 42-55 in *H. primaevus* and is 44 in No. 9764, but is 56 in *H. molossus*. This is not surely significant in itself, but it is striking in view of the fact that small individuals tend to have smaller indices while this,

one of the smallest known specimens of the genus, has the largest known index (except for *H. occidentalis*, an animal not far from twice this size).

A similar difference, not surely significant in itself but perhaps becoming so when related to the size of the skull, is seen in the index length of canine alveolus: prosthion-basion (E), which is 11.7 in the type of *H. molossus*. This is above the observed range in *H. primaevus* and is striking because in the latter species this index may be larger in large than in small individuals.

The postorbital constriction is somewhat below average diameter for *H. primaevus*, but does not differ noticeably from those of the skulls of that species most comparable in other dimensions, so that it is not really distinctive (nor is its index, D),

H. OCCIDENTALIS

Only four specimens surely of this species have been recorded in the literature and I know of no others. The type is a lower jaw fragment, lacking both ends, with P₄. Williston's type of *Dinotomius atrox* is a nearly complete skull and skeleton, and another closely similar specimen was found with this. Amer. Mus. No. 1407 is a complete mandibular ramus with the crowns of P₄ and M₁, correctly referred to this species by Adams. These specimens are much larger in every dimension than are those of *H. primaevus*, with its probable synonyms, and equally distinctive from *H. molossus*, the third probably valid Brulé species. The difference in gross size is unquestionably significant and the addition of the *H. occidentalis* specimens to the *H. primaevus* series would indicate a species much more variable than is warranted by any valid analogy. The only possible question is whether, as Scott and Jepsen (1936) implied by placing them in the synonymy of *H. occidentalis*, the specimens called *H. robustus* and *H. insolens* might not be females of this species rather than males of *H. primaevus*. From the point of view of the sexual dimorphism and variability implied, this is not impossible and perhaps it cannot be quite disproved on

as was at first thought. Scott and Jepsen (1936, p. 135) add that the constriction is remarkably anterior in position. I cannot judge the significance of this rather subtle character from the data now available. Along with some of the other characters, it is made questionable by Thorpe's statement that the only known specimen shows some post-mortem deformation.

Thorpe's statement that *H. molossus* has heavy, massive skeletal bones also suggests a distinction since small specimens of *H. primaevus* tend to have relatively slender bones.

Given only one specimen and the absence of absolute distinctions, it is possible that *H. molossus* is based on an abnormal specimen of *H. primaevus*, but the evidence suggests that it is distinct.

purely morphological grounds. It is, however, unlikely on the following grounds:

1.—If *H. "robustus"* and *H. "insolens"* do not belong to *H. primaevus* then that species (including the material referred to *H. "oreodontis"*) was much less variable and showed less sexual dimorphism than any comparable cats, machairodont or feline, as far as known.

2.—As demonstrated above, *H. primaevus* and "*oreodontis*," on one hand, and *H. "robustus"* and "*insolens*," on the other, nearly or quite intergrade in all their characters and show all the expected and probable resemblances and distinctions normal for the two sexes of a single species. It is highly improbable that the females of one species would so closely resemble and intergrade with another species living in the same region at the same time or that the morphological relationships of the females of one species to the males of another would so exactly correspond to the normal relationships of males to females of one species.

3.—It is very improbable that of two closely related species one would show great variation and extreme (even though not abnormal) sexual dimorphism, as would a species combining *H. occidentalis* with *H. "robustus"* and "*insolens*," while the other showed abnormally little variation and no evident dimorphism, as would a species including only *H. primaevus* and "*oreodontis*."

4.—The *H. occidentalis* specimens may be all of one sex, or may include three females and one male. This sex ratio in the sample and this degree of variation are well within limits of probability if these are the only specimens

known of the species. But if *robustus* and *insolens* are the females of the species, then all four specimens of *H. occidentalis* are males (and highly variable as such) and a sample of about twenty includes only four males. This is not impossible, but it is improbable.

Most of the proportions of these large specimens are about as in *H. primaevus*. Those that are more or less distinctive are, as a rule, correlated with size and show in *H. occidentalis* about what would be expected because of its large size. In other words, although the proportions are in some cases distinctive, give the species a characteristic appearance, and are aids in recognizing it, they may be merely consequences of its greater size and not separate genetic characters. Thus the facial-cranial index (B) is about 63 (calculated from Williston's apparently accurate figure), a very large figure well above the known range for *H. primaevus*, but in the latter this index is highly variable and apparently tends to be larger for larger individuals. The index of the postorbital constriction (D) is relatively small, but within the *H. primaevus* range and this index is generally smaller in larger animals. The canine index, E, is very large in Williston's specimen, 14.0, and probably does go beyond the limit of normal variation or of probable regression on size for *H. primaevus*, but the correlation in the latter is not close enough to show this beyond doubt. The proportions of the

other teeth and of the lower jaw show no striking peculiarities. The small brain, high emarginate sagittal crest, producedinion, and other peculiarities of Williston's specimen are also about what would be expected either in a large variant individual or in a large species.

H. occidentalis thus appears to be the only species known in the lower Brulé of South Dakota that is surely distinct from *H. primaevus*. The occurrence together of these two sharply different allied species is entirely normal. A definite ecological distinction is suggested. *H. primaevus* is abundant, *H. occidentalis* rare, also a normal situation when two allied cats occur together. The area of deposition was apparently mostly inhabited by the smaller species. The larger species may have been everywhere less common, but may also have lived mostly in a somewhat different environment and be represented here only by strays. One possible analogy is afforded by the occurrence of leopards and tigers in Asia.

It will be recalled that this fauna also includes *Dinictis*, probably with two valid species, and *Eusmilus*, with one. These are adaptively quite distinct from *Hoplophoneus* and complete a picture of a normally varied cat assemblage with five or six different sorts each occupying its own place in the general regional fauna.

AN INTERESTING NEW SPECIMEN

Amer. Mus. No. 38804, found by Mr. Thomson in the lower Brulé in 1938, includes skull, jaws, and most of the skeleton of a *Hoplophoneus* smaller than *H. occidentalis* but well above the average for *H. primaevus*. The prosthion-basion length, 181 mm., is slightly above that recorded for any Brulé specimen except Williston's "*Dinotomius atrox*" (= *H. occidentalis*), although the difference of only 2 mm. from the largest specimens referred to *H. insolens* and "*robustus*" is hardly significant. Although an unusually big animal, with the development of crests, etc., that goes with size, almost all its dimensions and proportions are within the observed range for the largest individuals

of *H. primaevus*, used in the broadest sense to include "*robustus*" and "*insolens*," or so near it that the deviation has no clear significance. The only exception is that the upper canines appear to be abnormally large, both relatively and absolutely. Crushing and fissuring of the specimen with subsequent filling of cracks with matrix make this not exactly measurable, but the anteroposterior diameter of the canine alveoli was probably about 22 mm. and the index, E, about 12. The largest values in the *H. primaevus* series are 17.5 mm. and, for the index, 11.1. The difference is not clearly significant in view of the imperfect preservation of the specimen and it is, after all, most likely that this is merely an

extreme variant of *H. primaevus*, about the most robust male known. The very fragmentary skull of Amer. Mus. No. 655, a syntype but not the lectotype of *H. insolens*, also belongs to a very large animal for this group and is peculiar in various

ways hard to evaluate on such imperfect material, among them the probable possession of upper canines absolutely and relatively very large, as in this new specimen.

CHADRON SPECIES

The described Chadron species are *H. mentalis* Sinclair and *H. oharrai* Jepsen. Their authors have described them fully and I have not re-examined any of the specimens so that I can add nothing except the suggestion that the two may be synonymous as already hinted but not definitely advanced by Wood (1927). The specimens rather closely resemble the most robust males of *H. primaevus*, but are probably correctly distinguished from that species. It is just possible that the dubious specimens mentioned above, Amer. Mus. Nos. 38804 and 655, represent a survival of this group, as a separate phylum, into the Brulé, but this is not probable.

Clark (1937) has reported the discovery of a specimen referred to *H. robustus* in the upper part of the Chadron, but has given no detailed description or measurements. A considerably larger sample of

Chadron specimens will be required to show the probable average distinctions corresponding with changes of level within this group.

A new specimen extending the geographic range is Amer. Mus. No. 27798, found by A. C. Silberling in beds of Chadron age on the west side of the Long Pine Hills in Carter Co., Montana. This consists of the cranium posterior to the postorbital constriction, part of the upper jaw with all six incisors and the left canine, and a fragment of the left lower jaw with P_1-M_1 . These remains do not permit exact identification, but the large canine and the size of the cranium and production and shape of its crests suggest *H. oharrai*. The lower jaw fragment is perhaps closest to *H. primaevus*, but the parts preserved show no good distinction between the two species.

TAXONOMIC CONCLUSIONS

The data summarized in preceding pages suggest the following conclusions regarding the eleven proposed White River species of this genus:

1.—*H. primaevus* (Leidy, 1851). Surely valid. As hitherto used, in a strict sense, the name has probably included most of the females and one or two small or young males of a natural species.

2.—*H. occidentalis* (Leidy, 1869). Surely valid. A second, larger, ecologically different, less abundant species.

3.—*H. oreodontis* (Cope, 1873). Now indeterminate but possibly determinable at some future time on the basis of the type. Cope's hypodigm of 1885 or neotype is probably an immature *H. primaevus* and is above rather than below the average size for that species. The small mature specimens later referred to *H. oreodontis* are thus different. They are probably the smallest females of *H. primaevus*.

4.—*H. atrox* (Williston, 1895). A synonym of *H. occidentalis*.

5.—*H. robustus* Adams, 1896. Probably includes most of the males of *H. primaevus*, of which it is thus a probable synonym. Very unlikely to be a synonym of *H. occidentalis*.

6.—*H. insolens* Adams, 1896. One or two specimens so identified may just possibly, but not probably, be distinctive. Other specimens, including the lectotype, appear to be merely the largest males of *H. primaevus*. Unlikely to be synonymous with *H. occidentalis*.

7.—*H. latidens* Thorpe, 1920. Probably based on slight variants of *H. primaevus*. They could represent a different race from most of the material, but the available specimens do not establish this as probable.

8.—*H. marshi* Thorpe, 1920. Similarly a possible race, but not demonstrated to be such. At present not distinguishable from immature *H. primaevus*.

9.—*H. molossus* Thorpe, 1920. Apparently valid, but data do not yet quite preclude the possibility that the known specimen is a deviant or abnormal *H. primaevus*.

10.—*H. mentalis* Sinclair, 1921. Probably

valid and almost surely so if *H. oharrai* is a synonym.

11.—*H. oharrai* Jepsen, 1926. Distinct from

any named Brulé species. Possibly synonymous with *H. mentalis* but this is not demonstrated.

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A MONOGRAPH OF THE GENUS *TRIGONURUS* (COLEOPTERA: STAPHYLINIDAE)

BY RICHARD E. BLACKWELDER

The genus *Trigonurus* is placed in our present classification of the family Staphylinidae in the subfamily Piestinae, the tribe Piestini, and the group Trigonuri. The accurate definition of these groups is not possible at the present time, but it can be said in general that the Piestinae are distinguished by having the anterior coxae small and globose, the posterior coxae small and approximate but either globose or transverse, by being without ocelli, and by having the 11-segmented antennae inserted at the lateral corners of the vertex near the eyes.

The tribe Piestini has the tarsi 5-segmented. The group Trigonuri has the elytra extending well beyond the apex of the metasternum. Only three genera are known in this group, *Apatetica*, *Nodynus*, and *Trigonurus*. The first two are confined to the Orient and differ from *Trigonurus* in having the tibiae keeled or grooved, by having the metasternal process longer, and in the broadly angulate sides of the pronotum. *Trigonurus* has a very distinct facies which makes it readily distinguishable from all other Staphylinids and gives it something of the appearance of a Nitidulid. When once recognized, it can scarcely be mistaken for anything else.

This genus was first recognized in Europe, where two species were known by 1865. Nothing new has been discovered in that part of the world since that time, except for slight extensions of the known range of one of the species. However, in 1874, Leconte described three species from the Pacific Coast of North America, and in 1875 Sharp described two more from the same region. One of Sharp's species has since been considered a synonym, one new species has been described recently by Van Dyke, and I am now presenting another

new species. The genus therefore now contains eight species (with one or two synonyms) of which one occurs in Europe proper, one in the Caucasus, and six in Pacific North America.

Two other specific names have been used in this genus. In 1895 Keen recorded a species from the Queen Charlotte Islands under the name *T. nebrionides* Fauvel. This is apparently a *nomen nudum* and very likely is the same as *T. crotchii* Leconte. In 1852 Maklin described *Lathrimaeum subcostatum* from Sitkha, Alaska. In the Henshaw catalog of 1885 it was kept in *Lathrimaeum* but in the Bernhauer and Schubert Coleopterorum Catalogus of 1910 (pars 19, page 5) it was transferred to *Trigonurus*. The Leng catalog of 1920 followed Bernhauer and Schubert, but in 1933 Scheerpeltz, in the supplement to the Coleopterorum Catalogus, restores the species to its original genus. Finally Van Dyke in 1934 writes, "I believe that this species is a true *Trigonurus* and quite close to *crotchii* Lec. if not identical. Its status, however, will have to remain in doubt until we are able to again collect in its type locality."

In none of these opinions upon the status of *subcostatus* do the respective writers give their reasons for the conclusions they have reached, and we are left to conclude that they are based upon the original description which is all that has been written about the species. Dr. Van Dyke examined the types of Sharp's species of *Trigonurus* in the British Museum, but he apparently failed to note a specimen in the same part of the box labeled "Lathr. subc. Maeklin Type." This specimen was also labeled *Trigonurus subcostatus* and Sitkha. Although the history of the specimen is not clear, there can be little doubt

that it is the actual type of *subcostatum* Mäklin, and the specimen itself leaves not the slightest doubt that it is a true *Lathrimaeum* very closely similar to *L. pictum* Fauvel and other species. It is therefore eliminated from our study of *Trigonurus*, as indicated by me in 1939 in the Fourth Supplement to the Leng Catalog.

Prior to the publication of Dr. Van Dyke's revision of the American species in 1934, I had discussed the problems of identification in the genus with Dr. Van Dyke and found that we differed considerably in our interpretations of certain of the species. I have not tried to check on how Dr. Van Dyke's identifications agree or disagree with my present opinions, but I now recognize several errors in my own previous arrangement. *T. rugosus* and *T. crotchii* I had properly identified; what I had identified as *T. edwardsi* now proves to be a new species; and my identifications of *caelatus* and *leconteus* proved to be both errors for *edwardsi*.

I believe that these difficulties, and those of other workers as well, were due almost entirely to the fact that the characters used in the original descriptions are not sufficient to separate the species. When studying the types in the British Museum, I found that it was possible to make a key based on other characters that are much more usable and reliable. But a subsequent attempt to find characters in the genitalia of both the males and the females showed that these do not offer characters of value, at least with ordinary methods of preparation. Sufficient definitive characters have been found, however, on other parts of the body to make both the classification and the identification of the species reasonably certain and easy.

The following institutions and persons have very kindly lent or otherwise made available specimens for this study, and I gratefully acknowledge their courtesy: American Museum of Natural History, United States National Museum, Museum of Comparative Zoölogy, California Academy of Sciences, British Museum (Natural History), Mr. Hugh B. Leech of Salmon Arm, B. C. Specimens received from the California Academy include those from

the general collections, the Blaisdell collection, and the Fenyes collection, but not those in the Van Dyke collection. Specimens studied in the Museum of Comparative Zoölogy include ones in the Leconte, Fall, Liebeck, Bowditch, and Blanchard collections.

TRIGONURUS MULSANT

Trigonurus MULSANT, 1847, p. 515.—GACIL, 1849, p. 258.—SCHAU, 1849, p. 148.—LACORDAIRE, 1854, pp. 120, 123.—DUVAL, 1857, p. 61.—REDTENBACHER, 1858, p. 239.—REICHE, 1865, pp. 641, 642.—SOLSKY, 1868, pp. 161, 162.—FAUVEL, 1872, p. 17.—SHARP, 1874, p. 421.—REDTENBACHER, 1874, p. 263.—SHARP, 1875, p. 204.—MULSANT AND REY, 1878, pp. 212, 214.—FAUVEL, 1878, p. 185.—SHARP, 1889, p. 467.—GANGLBAUER, 1895, p. 682.—HEYDEN, REITTER, AND WEISE, 1906, p. 126.—BERNHATER AND SCHUBERT, 1910, p. 5.—SCHAUFFER, 1916, p. 147.—LENG, 1920, p. 92.—HANDLIRSCH, 1925, p. 571.—PORTEVIN, 1929, p. 429.—SCHEERPELTZ, 1933, p. 993.—VAN DYKE, 1934, pp. 177, 178.—BLACKWELDER, 1939, p. 22.

Trigonurus KEEN, 1895, p. 172 (misspelling). GENOTYPE.—*Trigonurus mellyi* Mulsant (monobasic).

DIAGNOSIS.—Frontal sutures complete between the antennal fossae; postclypeus not attaining the eyes, the antennae inserted at the anterior lateral corners of the vertex near the eyes; labrum with delicate lateral appendages; without ocelli; compound eyes complete; antennae 11-segmented, not abruptly pubescent from any particular segment; mandibles without teeth; lacinia of maxilla much shorter than the galea; maxillary palpus 4-segmented; submentum separated from gula by union of submental sutures in front of gular pits; prementum divided into three small triangular sclerites; labial palpus 3-segmented, short and stout; elytra longer than the metasternum; alate; prosternum very narrowly and briefly produced between the coxae; the mesothoracic spiracles lying in the membrane near the pronotal lobes; meso- and metasternal lobes meeting midway between the mesothoracic coxal declivities; first abdominal segment entirely absent, second represented by a tergite alone, third to seventh with one paratergite on each side; intersegmental membranes of abdomen apparently entirely without minute sclerotizations; lateral plates of ninth segment not united either above or below; the male genitalia consist of a strong sclerotic tube with a bulbous base, a small median foramen situated ventrally at the junction of the tube and the bulb and between the base of the lateral lobes, the latter lying along the median lobe; all tarsi 5-segmented; anterior coxae globose; hind coxae contiguous, expanded laterally and caudally into a plate that is partly covered by the femur in repose.

REMARKS.—The history of the study of this genus taxonomically has been outlined above, but the actual history of the genus itself is not so clear. The genus has been found only in three widely separated mountain systems. This distribution is easily explained by the assumption that these areas are all that is now left of what was once a very extensive united habitat. Other explanations are possible also, and it is scarcely the place of this study to attempt to decide. There is little possibility of question that the eight species do form a single natural genus, since the one species which departs most from the general condition is one of the North American ones.

I have not been able to examine the two other genera which are placed in the group Trigonuri. These are *Apatetica* and *Nodynus*. The published descriptions and notes are not sufficient to permit a definite statement of their relationships. There is apparently little chance of confusing them with *Trigonurus*.

Inasmuch as I have not been able to examine the two European species (except *mellyi* briefly), I have not tried to make a key to include all the eight known species. *T. mellyi* will run in the following key to North American species to *T. sharpi*. From the descriptions it appears to differ from *sharpi* in having the elytral series of punctures somewhat impressed to form striae with the intervals feebly carinate. It also is said to have the eighth series excavated in a longitudinal fossa in apical fifth, whereas *sharpi* could scarcely be described in this way. *T. mellyi* is said to be about 5.1, 2 mm. long, while *T. sharpi* is never over 4.1, 2 mm. long.

I am unable to place *T. asiaticus* in relation to the other species. It seems to be very similar to *T. mellyi* but may differ in many details. It apparently has the pronotum finely strigulose and opaque, but the condition of the outer elytral striae or the hypomera is not recorded. Here again the recorded size is greater than for any of our species except *dilaticollis*.

KEY TO NORTH AMERICAN SPECIES OF
Trigonurus

- 1.—Hypomera impunctate or with few punctures.....2.

- Hypomera coarsely punctate throughout. 4.
2.—Eighth elytral stria deeply and coarsely punctured.....3.
Eighth stria obsolescent.....*crotchii*.
3.—Pronotum not at all strigulose.....*edwardsi*.
Pronotum more or less strigulose.....*sharpi*.
4.—Pronotum and elytra constricted at base.
.....*dilaticollis*.
Pronotum and elytra not narrowed at base.....5.
5.—Pronotum densely rugosely punctate throughout; elytral series of punctures irregular, especially posteriorly; eighth series very confused, generally extending nearly to humerus.....*rugosus*.
Pronotum not rugose on disk, with flattened shining intervals; elytral series only slightly irregular and traceable to apex; eighth series with large distinct punctures, not extending much beyond middle from apex.....*caelatus*.

Trigonurus edwardsi Sharp

Trigonurus edwardsi SHARP, 1875, p. 205.—FATVET, 1878, pp. 185, 186, 188.—BERNHACER AND SCHUBERT, 1910, p. 5.—LENG, 1920, p. 92.—VAN DYKE, 1934, pp. 177, 178, 179, 180, 182.—BLACKWELDER, 1939, p. 22.

DESCRIPTION.—Piceorufous. Head with two distinct longitudinal impressions and with frontal suture impressed; not finely but irregularly punctate, especially in front. Pronotum about three-fourths as long as wide, widest at base; sides sinuate but not distinctly converging until apical third, front angles obtuse but distinct; evenly convex except for a narrow shallow depression along midline and a broad concavity at each posterior angle; punctures irregular in size, not coarse on the disk and not crowded; the depressions more coarsely punctate; without strigulose ground sculpture. Hypomera with a few scattered small punctures near the sternum and coarse ones on the posterior lobe. Prosternum coarsely punctate throughout. Elytra conjointly over three-fourths as wide as long, one-eighth wider than pronotum, widest about middle and feebly narrowed to base and apex; humeral angles prominent, apex truncate, with outer angles narrowly rounded; not striate but with nine longitudinal series of coarse punctures, the first seven regular and complete, the eighth present only in apical third or half; intervals shining. Abdomen very finely and obsoletely punctured on the disk, more coarsely at the sides; with fine strigulose ground sculpture. Length, 3 3/4 to 4 mm.

TYPE LOCALITY.—(California).

TYPES.—Holotype (type) and one paratype (cotype) in the Sharp collection in the British Museum; one paratype (independent type) in the Museum of Comparative Zoölogy (No. 7372).

RECORDS.—The following are the records known to me:

CALIFORNIA: (Sharp, 1875; Fauvel, 1878; Leng, 1920), Southern California (Leng, 1920); SANTA CRUZ COUNTY (Nunenmacher, in Blackwelder coll.), Santa Cruz Mountains (A. Koebele, in U. S. Nat. Mus.; Blaisdell coll., in Cal. Acad. Sci.); SANTA CLARA COUNTY, Los Gatos (Hubbard and Schwarz, in U. S. Nat. Mus.), Santa Cruz (Van Dyke, 1934).

OREGON: (A. Koebele, in Blackwelder coll.).

ERRONEOUS OR DOUBTFUL RECORDS.—The following records have not been verified and are doubted for the reasons given in each case:

California: Marin County, Guerneville; Sonoma County, Hydesville; Humboldt County (Van Dyke, 1934). This species was not distinguished by Van Dyke from *sharpi*, to which these records probably pertain.

Washington: Port Angeles, The Forks, Seattle (Van Dyke, 1934). (Same comments as above.)

SPECIMENS EXAMINED.—I have studied all three of the types, two in the British Museum and one in the Museum of Comparative Zoölogy. In addition I have seen 11 examples in the U. S. National Museum, one in The American Museum of Natural History, one in the California Academy of Sciences, and seven in my own collection.

REMARKS.—This species may be at once distinguished from all the other American species by the nearly impunctate hypomera and the absence of strigulose ground sculpture on the pronotum.

The actual type locality is not known, but it is probably Central California. The types were collected by Henry Edwards of San Francisco.

Three specimens from Oregon in my collection, received in 1932 from Mr. F. W. Nunenmacher of Piedmont, California, are quite indistinguishable from the Santa Cruz examples. They have been compared directly both with the type in the British Museum and with the paratype in the Museum of Comparative Zoölogy. They are labeled only "Or." and "A. Koebele Collector." There must be some doubt as to the accuracy of these labels,

although the identification seems to be positive. One of these specimens bears an identification label from Col. T. L. Casey, as *T. lecontei*. There undoubtedly is another example from this lot in the Casey collection.

I find no records of the habits of this species.

Trigonurus sharpi, new species

DESCRIPTION.—Piceorufous. Head without distinct depressions but slightly elevated at center of vertex; frontal suture visible but not much impressed; punctures irregular, very sparse behind the frontal suture. Pronotum about one-sixth or one-fifth wider than long, widest at middle, nearly parallel to base, sides in front nearly straight but rather strongly converging; front angles obtuse but distinct, basal angles nearly right; evenly convex except for an irregular depression along midline and an indistinct arcuate one before the scutellum with the arms extended toward the anterior angles, and a broad concavity at each posterior angle; punctures very irregular in size, a few very coarse on the disk and in the depressions, the rest moderately small and separated by about their diameter; with more or less distinct strigulose ground sculpture. Hypomera with a few scattered small punctures near the sternum and coarse ones on the posterior lobe. Prosternum coarsely punctate throughout. Elytra conjointly over one-sixth longer than wide, one-seventh wider than pronotum, widest about middle and feebly narrowed to base and apex; humeral angles prominent, apex feebly arcuate with outer angles rather broadly rounded; without distinct striae but with nine longitudinal series of coarse punctures, the first seven regular and complete, the eighth strongly punctate and regular apically, sometimes confused basally or incomplete; the intervals narrow but shining. Abdomen moderately finely punctate, as densely on the disk as at the sides; with very feeble strigulose ground sculpture. Length, $3\frac{1}{2}$ to $4\frac{1}{2}$ mm.

TYPE LOCALITY.—Del Norte County, California.

Types.—Holotype, No. 54293, U. S. National Museum, collected on May 27, 1910 by F. W. Nunenmacher. Seven paratypes with same data; three from Inverness, Tamales Bay, Marin County, California, collected by Dr. F. E. Blaisdell on July 1st; two from Depoe Bay, Lincoln County, Oregon, collected on April 25, 1936 by K. M. Fender; one from Vancouver Island, British Columbia, collected April 29, 1896; and five from Vancouver, British Columbia, collected on October 18,

1931, by Hugh B. Leech. These paratypes are distributed among the following collections: U. S. National Museum, American Museum of Natural History, California Academy of Sciences, British Museum, Fall collection in the Museum of Comparative Zoölogy, H. B. Leech collection, and Blackwelder collection.

RECORDS.—The following are the records known to me:

CALIFORNIA: DEL NORTE COUNTY (Nunenmacher, in U. S. Nat. Mus., Brit. Mus., Blackwelder coll.); HUMBOLDT COUNTY, Fieldbrook (U. S. Nat. Mus.); SANTA CLARA COUNTY, Corte Madera Creek (Blackwelder coll.); SONOMA COUNTY, Stewarts Point (Blackwelder coll., Leech coll.), Duncan Mills (Cal. Acad. Sci.), Inverness, Tamales Bay (Cal. Acad. Sci., Amer. Mus. Nat. Hist.); SANTA CRUZ COUNTY, Santa Cruz Mountains (Fall coll. in Mus. Comp. Zoöl.).

OREGON: Cannon Beach (Blackwelder coll.), Depoe Bay (Leech coll.); LINN COUNTY, Albany (U. S. Nat. Mus.); LINCOLN COUNTY, Waldport (U. S. Nat. Mus.); JOSEPHINE COUNTY (Blackwelder coll.); WASHINGTON COUNTY, Dilley (Leech coll.); BENTON COUNTY, Corvallis (Fall coll. in Mus. Comp. Zoöl.).

WASHINGTON: THURSTON COUNTY, Olympia (Fall coll. in Mus. Comp. Zoöl.).

BRITISH COLUMBIA: NEW WESTMINSTER DISTRICT, Vancouver (Blackwelder coll., Cal. Acad. Sci., Leech Coll.); VANCOUVER ISLAND DISTRICT, Vancouver Island (Fall coll. in Mus. Comp. Zoöl.).

SPECIMENS EXAMINED.—I have seen ten examples in the U. S. National Museum, nine in the California Academy, one in the American Museum, five in the Fall collection in the Museum of Comparative Zoölogy, seven in the collection of H. B. Leech, and 18 in my own collection.

REMARKS.—This species may be at once distinguished from all other American species by the strigulose sculpture of the pronotum and the nearly impunctate hypomera. There is considerable variation in the distinctness of the strigulae, but they are always present in this species,

whereas in *edwardsi* there is no trace of them at all. The pronotum is relatively longer than in *edwardsi*, and the punctation of the abdomen is not obsolescent on the disk as in that species.

Specimens of this species have to my knowledge never been collected at the same place and time as *T. edwardsi*. If the Koebele Oregon records of *edwardsi* are doubted, then the ranges of the two species meet in the Santa Cruz Mountains.

A specimen from Oregon in the Riley collection in the U. S. National Museum was labeled *T. edwardsi* var. Examples in my collection were identified by T. L. Casey for F. W. Nunenmacher as *T. crotchii*. An example in the Fenyes collection in the California Academy of Sciences was labeled *T. crotchii*. Other examples have been labeled *T. edwardsi* in various collections.

Several Vancouver specimens were taken "under bark," but I find no other record of the habits of the species.

Trigonurus crotchii Leconte

Trigonurus crotchii LECONTE, 1874, p. 48.—SHARP, 1875, p. 205.—FAUVEL, 1878, pp. 185, 187.—BERNHAEUER AND SCHUBERT, 1910, p. 5.—KEEN, 1905, p. 297.—LENG, 1920, p. 92.—VAN DYKE, 1934, pp. 177, 178, 180, 181, 182.—BLACKWELDER, 1939, p. 22.

Trigonurus lecontei SHARP, 1875, pp. 205, 206.—BLACKWELDER, 1939, p. 22.

Trigonurus lecontei SHARP, 1875, p. 206.—BERNHAEUER AND SCHUBERT, 1910, p. 5.—LENG, 1920, p. 92.—BLACKWELDER, 1939, p. 22.

Trigonurus leconteus SHARP, FAUVEL, 1878, pp. 185, 187.—VAN DYKE, 1934, pp. 177, 178.

DESCRIPTION.—Piceous to testaceous. Head without distinct longitudinal depressions but feebly elevated at middle of vertex; frontal suture distinct and somewhat impressed; punctures sparse and fine. Pronotum three-fourths to two-thirds as long as wide, widest at basal third, thence very slightly narrowed to base and anterior third, from anterior third more narrowed but not arcuately; the anterior angles rounded, the basal angles nearly right; feebly convex and more or less flattened on the disk; midline shallowly but abruptly impressed, and with a less distinct short transverse impression just before base, and a broad shallow concavity at each posterior angle; punctures moderately coarse, generally separated by about half their diameters by fairly flat intervals; with indistinct strigulose ground sculpture. Hypomera impunctate except on the lobes. Prosternum with coarse punctures obliterated to form coarse rugose sculpture. Elytra con-

jointly three-fourths as wide as long, one-tenth wider than pronotum; widest along middle and feebly narrowed to base and apex; humeral angles prominent, apex feebly arcuate with lateral angles rather narrowly rounded; with distinct impressed striae strongly punctate but with the punctures somewhat indefinite; the first seven striae complete and regular, the eighth obsolescent, less coarsely punctate and visible only posteriorly; intervals shining but minutely uneven. Abdomen moderately punctate above, a little more densely at the sides; with vague traces of ground sculpture. Length, $3\frac{1}{2}$ to $4\frac{3}{4}$ mm.

TYPE LOCALITY.—“Vancouver,” British Columbia. Of *lecontei*, California.

TYPES.—Holotype, No. 6617, Leconte collection in the M.C.Z.; one paratype in the Sharp collection in the British Museum. Of *lecontei*, holotype in the British Museum.

RECORDS.—The following are the records known to me:

CALIFORNIA: (Amer. Mus. Nat. Hist.; Leconte coll. in Mus. Comp. Zool.), Sylvania (Bowditch coll. in Mus. Comp. Zool.); HUMBOLDT COUNTY (Blackwelder coll.), Fieldbrook (U. S. Nat. Mus.); MONTEREY COUNTY, Monterey (Fenyès, in U. S. Nat. Mus.; Liebeck coll. in Mus. Comp. Zool.), Pacific Grove (Fenyès and Blaisdell, in Cal. Acad. Sci.; Mann, in Blackwelder coll.), Carmel (Van Dyke, 1934); SANTA CRUZ COUNTY, Santa Cruz Mountains (U. S. Nat. Mus.); SANTA CLARA COUNTY, Los Gatos (U. S. Nat. Mus.); SAN BERNARDINO COUNTY (U. S. Nat. Mus.), Hesperia (U. S. Nat. Mus.); SONOMA COUNTY (Fall coll. in Mus. Comp. Zool.), Cazadero (Van Duzee, in Cal. Acad. Sci.); Duncan Mills (Blaisdell, in Cal. Acad. Sci.); SHASTA COUNTY, Castle Crag (Fenyès, in Cal. Acad. Sci.); LAKE COUNTY, Bartlett Springs (Fenyès, in Cal. Acad. Sci.); SISKIYOU COUNTY, Duns-muir (Fenyès, in Cal. Acad. Sci.).

OREGON: (Riley, in U. S. Nat. Mus.); JOSEPHINE COUNTY (Nunemacher, in Blackwelder coll.); LINN COUNTY, Santiam (Fall coll. in Mus. Comp. Zool.).

WASHINGTON: GRAYS HARBOR COUNTY, Hoquiam (Burke, in U. S. Nat. Mus.); THURSTON COUNTY, Tenino (Hubbard and Schwarz, in U. S. Nat. Mus.);

PIERCE COUNTY, Tacoma (Fall coll. and Blanchard coll. in Mus. Comp. Zool.).

BRITISH COLUMBIA: NEW WESTMINSTER DISTRICT, Vancouver (Leconte, 1874; Fauvel, 1878; Leech, in Cal. Acad. Sci.).

ERRONEOUS OR DOUBTFUL RECORDS.—The following records have not been verified and are doubted for the reasons given in each case:

California: Sierras of California (Leconte, 1874; Fauvel, 1878). (*T. crotchii* was described from specimens from “Vancouver Island and Sierra of California.” The Leconte collection now contains a single example, labeled “Vanc.” The Sharp collection in the British Museum contains two examples received from Dr. Leconte, labeled merely California. That these came from the Sierra Nevada Mountains is doubtful because of the complete lack of later records from east of Shasta County.) Marin County, Inverness (Van Dyke, 1934). (This record is somewhat doubtful because of the commonness of *T. sharpi* at this locality. The segregation of this species necessitates a reexamination of these specimens.) Eldorado County, Soda Springs (Blaisdell, in Calif. Acad. Sci.). (I can find no such locality as Soda Springs in Eldorado County. There is such a town near Truckee in Nevada County, but this species seems to be restricted to the Coast Ranges. There is a possibility that this is an error for Soda Spring, Mendocino County, which is well within the known range of the species.)

British Columbia: Queen Charlotte Islands (Van Dyke, 1934). (Dr. Van Dyke assumes the synonymy of *T. nebrivoides* Fauvel, MS. of Keen, 1895, with *T. crotchii*. It will be necessary to examine the specimens to determine which species is involved.) Coast District (Keen, 1905). (This determination was probably made by Prof. H. F. Wickham. Since the latter had in his collection only one of the three species involved, it is unwise to assume that the determination is correct.)

Alaska: (Van Dyke, 1934). (This record is apparently based upon *T. subcostatus* Mäkl. which Dr. Van Dyke be-

lieves to be a synonym of *T. crotchii*. That it is distinct I have tried to prove above.)

SPECIMENS EXAMINED.—I have studied the types in both the Leconte and Sharp collections and have seen in addition 37 examples in the U. S. National Museum, six in The American Museum of Natural History, 39 in the California Academy of Sciences, one in the British Museum, five in the Leconte collection in the Museum of Comparative Zoölogy, four in the Bowditch collection, three in the Blanchard collection, and 18 in my own collection.

REMARKS.—This species may be distinguished from all other American species by its obsolescent eighth elytral series; it is also the only one in which the elytral striae are distinctly impressed.

Some of the localities listed above as doubtful may be found to be valid, but the extension of the range into Alaska is at least at present doubtful. This appears to be the commonest coastal species, but the largest number of specimens taken at any one time appears to be 13, collected by F. W. Nunenmacher in Josephine County, Oregon. A series of 23 was collected by Dr. F. E. Blaisdell at Duncan Mills, California on June 26, 28, 30, and July 16, in 1908.

T. leconteus Sharp was recognized as a synonym of *T. crotchii* by Van Dyke in 1934 and by Blackwelder in 1939, in each case after an examination of the types of both species. Dr. H. C. Fall had come to the same conclusion after an examination of the Leconte collection, and recorded the fact in his notebook (now in the Museum of Comparative Zoölogy).

No matter what the disposition of *leconteus* there is no justification for the change of the spelling to *leconteus* or *lecontei*. Dr. Sharp specifically states, "I have used the trivial word *Leconteus*, in preference to *Lecontei*, a word of which the pronunciation at least is ambiguous." Although our International Rules (Article 14) state that "If the (specific) name is a modern patronymic, the genitive is always formed by adding to the exact and complete name, an *i* if the person is a man. . .," they do not say that names based upon the names of persons must be placed in the genitive.

And they do say (Article 19) that "The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident."

Two Vancouver specimens were found under bark of *Abies* sp. Dr. Van Dyke's records from two species of *Pinus* depend on the identification of the specimens.

Trigonurus caelatus Leconte

Trigonurus caelatus LECONTE, 1874, p. 48.—SHARP, 1875, p. 205.—FAUVEL, 1878, p. 185, 186, 187.—BERNHAEUER AND SCHUBERT, 1910 p. 5.—LENG, 1920, p. 92.—VAN DYKE, 1934, pp. 177, 178, 179, 181, 182.—BLACKWELDER, 1939, p. 22.

DESCRIPTION.—Piceorufous to rufotestaceous. Head almost entirely without longitudinal impressions, with frontal suture somewhat impressed; rather densely punctate behind the frontal suture, very sparsely before. Pronotum five-sixths as long as wide, widest just behind middle; sides not at all angulate, nearly straight in basal third and gradually rounded to front angles which are rather broadly rounded; basal angles nearly right; disk fairly evenly convex, except for a shallow and indefinite median longitudinal depression, a feeble semicircular depression in front of scutellum, and a broad but feeble concavity at each posterior angle; punctures rather coarse with intervals varying in width but not rugose, with much smaller punctures interspersed but without strigulose ground sculpture. Hypomera coarsely punctate throughout. Prosternum with coarse punctures throughout but shallower medially. Elytra conjointly nearly five-sixths as wide as long, one-sixth wider than pronotum, widest at basal two-fifths and moderately evenly narrowed to base and apex; humeral angles somewhat prominent, apex diagonally truncate with outer angles narrowly rounded; not striate but with nine longitudinal series of coarse punctures, the first seven usually fairly regular and complete but sometimes irregular posteriorly or somewhat rugose in front, the eighth fairly regular and extending little past the middle from the apex; the intervals shining. Abdomen not very finely punctate, about as densely at center as at sides; with very fine strigulose ground sculpture. Length, 4 to 5 mm.

TYPE LOCALITY.—Sierras of California.

TYPES.—Lectotype, No. 6616, Leconte collection in the Museum of Comparative Zoölogy; one paratype in the same collection and one in the Sharp collection in the British Museum.

RECORDS.—The following are the records known to me:

CALIFORNIA: (Leconte coll. in Mus. Comp. Zool.), Sierras of California (Leconte, 1874; Fauvel, 1878), Riverton (Hinton, in Blackwelder coll. and Cal. Acad. Sci.); EL Dorado COUNTY (Nunemacher, in Blackwelder coll.), Pacific (Hinton, in Blackwelder coll. and Cal. Acad. Sci.); TUOLUMNE COUNTY, Mill (Hinton, in Blackwelder coll. and Cal. Acad. Sci.); ALPINE COUNTY (Blaisdell, in Cal. Acad. Sci.); TULARE COUNTY (Blaisdell, in Cal. Acad. Sci.); FRESNO COUNTY, Huntington Lake (Blaisdell, in Cal. Acad. Sci.); CALAVERAS COUNTY, Big Trees (Blaisdell, in Cal. Acad. Sci.), Douglas Station (Hinton, in Blackwelder coll.); SAN JOAQUIN COUNTY, Calaveras (U. S. Nat. Mus.; Fall coll. in Mus. Comp. Zool.); MARIPOSA COUNTY, Miami (Fenyès, in Cal. Acad. Sci.).

ERRONEOUS OR DOUBTFUL RECORDS.—The following records have not been verified and are doubted for the reasons given in each case:

California: Sierra Nevada Mountains . . . everywhere . . . from Shasta County to Tulare County (Van Dyke, 1934). (I believe it likely that part of these records are based on misidentifications of *rugosus*).

SPECIMENS EXAMINED.—I have studied the two types in the Leconte collection and the paratype in the British Museum, and also two examples in the U. S. National Museum, 28 in the California Academy of Sciences, 2 in The American Museum of Natural History, 10 in various collections in the Museum of Comparative Zoölogy, and 17 in my own collection.

REMARKS.—This species can be readily distinguished from the other American species except *rugosus* by the characters given in the key. From *rugosus* it is sometimes separated with difficulty as is explained below.

Dr. Van Dyke records *caelatus* from the Sierras "from Shasta County to Tulare County" and *rugosus* from "the mountains in the neighborhood of Mt. Shasta." Of *rugosus* he writes that it "may prove to be but a subspecies of *caelatus*. So far it stands apart and should be considered as distinct until we can find specimens from presumed intermediate territory which

bridge the gap between the two." Under my interpretation of these species, *rugosus* ranges from Siskiyou and Shasta counties to Lake Tahoe but has been found only at considerable altitudes (over 5000 feet) at least in the southern part of its range. On the other hand *caelatus* occurs from Tulare County to Alpine and Eldorado Counties in the foothills and western slope of the Sierras with few records of its occurrence in the higher parts of the mountains except in the south.

However, these two species are not definitely distinguishable by any single character. Specimens of *caelatus* even from the southern parts of the range occasionally show one or two of the characters used here to distinguish *rugosus*. On the other hand no example from the northern Sierras (presumably *rugosus*) has been seen to have any of the characters assigned to *caelatus*. It is therefore still necessary to conclude that these two species are closely related, that they may represent merely two subspecies, and that many more records and hours of study are required to furnish a definite solution. At present the known ranges do not actually overlap and specimens are identifiable without reference to the locality.

This species was recorded by Leconte from under bark of pine and by Dr. Van Dyke from under bark of yellow pine.

Trigonurus rugosus Sharp

Trigonurus rugosus SHARP, 1875, pp. 204, 205.—FAUVEL, 1878, p. 185.—BERNEHAUER AND SCHUBERT, 1910, p. 5.—LENG, 1920, p. 92.—VAN DYKE, 1934, pp. 177, 178, 179, 182.—BLACKWELDER, 1939, p. 22.

DESCRIPTION.—Piceorufous to rufotestaceous. Head unimpressed except feebly along frontal suture; densely and not very finely punctate, much sparser before the frontal suture. Pronotum five-sixths as long as wide, widest at basal third, feebly narrowed to base, nearly parallel to anterior third, thence moderately narrowed to prominently rounded anterior angles, basal angles nearly right; disk evenly convex except for an indefinite and feeble impression along the midline, another of indefinite shape transversely near base, and a broad concavity at each posterior angle; punctures coarse and dense, the intervals more or less rugose, very seldom smooth or with distinct smaller punctures, punctures not coarser in the depressions; without strigulose ground sculpture. Hypomera

coarsely punctate throughout. Prosternum coarsely punctate throughout. Elytra conjointly seven-ninths as wide as long, nearly one-eighth wider than pronotum, widest along middle and feebly narrowed to base and apex; humeral angles moderately prominent, apex feebly arcuate but outer angles broadly rounded; not striate but with nine longitudinal series of coarse punctures, the intervals irregularly diagonally rugose near scutellum, the punctures somewhat irregular apically especially near the suture, the eighth with punctures fairly coarse but irregular and frequently doubled, usually extending nearly to humerus; intervals shining. Abdomen with moderately coarse but shallow punctures not denser medially but a little less coarse; with fine strigulose ground sculpture. Length, $4\frac{1}{2}$ to 5 mm.

TYPE LOCALITY.—California.

TYPES.—Type and 15 other examples (one labeled paratype) in the British Museum. One "Independent type" from the Sharp collection is now in the Leconte collection in the Museum of Comparative Zoölogy.

RECORDS.—The following are the records known to me:

CALIFORNIA: (Bowditch coll. in Mus. Comp. Zoöl.; Sharp, 1875; Fauvel, 1878); PLACER COUNTY (Koebele, in U. S. Nat. Mus.), Lake Tahoe (Fuchs, in Amer. Mus. Nat. Hist.; U. S. Nat. Mus.; Blackwelder coll.; Fall coll. in Mus. Comp. Zoöl.); EL DORADO COUNTY, Tallac (Fenyès, in Cal. Acad. Sci.; Fall coll. in Mus. Comp. Zoöl.); NEVADA COUNTY, Truckee (Wickham, in Cal. Acad. Sci.); SISKIYOU COUNTY, McCloud (Fenyès, in Cal. Acad. Sci.), Sisson (Wickham, in U. S. Nat. Mus.); PLUMAS COUNTY, Mohawk (Fenyès, in U. S. Nat. Mus.; Fall coll. in Mus. Comp. Zoöl.); SHASTA COUNTY, Mt. Shasta region (Van Dyke, 1934).

NEVADA: Lake Tahoe (U. S. Nat. Mus.).

SPECIMENS EXAMINED.—I have studied the types in both the British Museum and the Museum of Comparative Zoölogy. In addition I have examined 26 specimens in the U. S. National Museum, six in the California Academy of Sciences, three in The American Museum of Natural History, 14 in the British Museum, two in my own collection, and one in the Leconte collection, four in the Fall collection, one in

the Bowditch collection (all in the Museum of Comparative Zoölogy).

REMARKS.—This is a very distinct species in appearance but is difficult to separate from *caelatus* because of the variability of the latter species. Notes on these two will be found under *caelatus*.

I do not question Dr. Van Dyke's record of *rugosus* from the "neighborhood of Mt. Shasta" since there is little question of the identification and his description and figure leave no doubt of it. I believe, however, that Dr. Van Dyke has erred in the identification of *caelatus* from north of Lake Tahoe and that these records should be listed as *rugosus* which certainly does occur as far south as Lake Tahoe. Re-examination of the specimens will doubtless settle this matter readily.

The possibility of *rugosus* being merely a subspecies of *caelatus* is unaffected by these records, since the ranges still meet, merely at a more southern point than thought by Dr. Van Dyke. This cannot be settled by random collections no matter how well these cover the intermediate territory, since it is absolutely necessary to know the variation of each species. This can only be determined from a long series collected at one time and place, and preferably from several such series. The largest series that I have seen contain only 7 and 8 specimens of *rugosus* and only 10 and 13 specimens of *caelatus*. These indicate that *caelatus* is more variable, but they are insufficient to be at all conclusive.

There is no question that these two species differ from each other less than from other members of the genus. But there is no necessity for all our species being of equal isolation or at corresponding stages of evolution. Subspecies may at times be embryonic species, but, until the subspecific status can be reasonably well demonstrated, it is much easier for us to record the known data under two species.

I find no record of the habits of this species.

Trigonurus dilaticollis Van Dyke

Trigonurus dilaticollis VAN DYKE, 1934, pp. 178, 179, 182.—HOPPING, 1936, p. 65.—BLACKWELDER, 1939, p. 22.

DESCRIPTION.—Piceous to piceorufous. Head

without longitudinal impressions but with frontal suture finely impressed, with a broad fovea at each end of the frontal suture; rather finely punctate, but less distinctly before the frontal suture. Pronotum three-fifths as long as wide, widest near middle, the sides broadly rounded, arcuately narrowed in front, the sides becoming nearly straight basally but the base much narrower than middle; the front angles obtuse and not prominent, the basal angles nearly right; feebly convex with disk flattened throughout the length, the midline vaguely depressed, and with a very large and deep fovea at each posterior angle; the punctures fairly coarse, slightly elongate and occasionally united in longitudinal groups; the intervals generally less than half as wide as the punctures but flat, with indistinct strigulose ground sculpture. Hypomera densely and coarsely punctate throughout. Prosternum with very coarse punctures becoming transversely elongate near middle. Elytra conjointly three-fourths as wide as long, one-fifth wider than pronotum, widest along middle and feebly narrowed toward base and apex, but with basal and apical angles broadly rounded making the elytra appear to be narrowed at base, apex truncate but conjointly triangularly emarginate at middle; very feebly striate but with the striae marked by series of very coarse punctures, generally regularly placed but somewhat obscured by very irregular punctulae on the moderately convex intervals, the outer more obscured though more impressed and the seventh scarcely traceable. Abdomen with moderately coarse shallow punctures about as dense at middle as sides; with feeble strigulose ground sculpture. Length, 6 mm.

TYPE LOCALITY.—California, Lagunitas Canyon, Marin County.

TYPES.—Holotype, No. 3850, California Academy of Sciences, collected by Dr. E. C. Van Dyke on April 9, 1911.

RECORDS.—The following are the records known to me:

CALIFORNIA: MARIN COUNTY, Lagunitas Canyon (Van Dyke, 1934), Sylvania (U. S. Nat. Mus.).

BRITISH COLUMBIA: Pender Harbor (Hopping, 1936); Steelhead (Hopping, 1936; H. B. Leech, in Leech coll., Fall coll. in Mus. Comp. Zool., and Blackwelder coll.); Vancouver (U. S. Nat. Mus.).

SPECIMENS EXAMINED.—I have examined Dr. Van Dyke's type briefly and have studied two examples in the U. S. National Museum, one in Mr. Leech's collection, one in the Fall collection in the Museum of Comparative Zoölogy, and one in my own collection.

REMARKS.—This species is very distinct from all the other American species by the shape of the pronotum and elytra. The name implies that the pronotum is dilated but in reality it is merely cut away at the base. This illusion is increased by the unusually rapid narrowing of the base of the elytra. The species is also very distinct by the presence of the irregular punctulae on the narrow intervals of the coarse elytral punctures. This is the cause of the general dull appearance.

Two specimens of this species in the Hubbard and Schwarz collection in the United States National Museum were separated out as a new species by Dr. E. A. Chapin before Dr. Van Dyke's description appeared. The MS. name placed on these specimens is not included in the synonymy of this species since it has not gotten into either the literature or other collections.

The species was originally found under bark of *Sequoia sempervirens* but must live in other trees at least in the northern localities.

Trigonurus Mellyi Mulsant

Trigonurus mellyi MULSANT, 1847, p. 516, Pl. VII, fig. 2.—GAUBIL, 1849, p. 258.—LAGORDAIRE, 1854, p. 123.—DUVAL, 1857, p. 61, Pl. XXIII, fig. 113.—REDTENBACHER, 1858, p. 239.—REICHE, 1865, p. 642.—SOLSKY, 1868, p. 161.—FAUVEL, 1872, p. 17.—LECONTE, 1874, p. 48.—SHARP, 1874, p. 421.—REDTENBACHER, 1874, p. 263.—SHARP, 1875, p. 204.—MULSANT AND REY, 1878, p. 214.—GÄNGLBAUER, 1895, p. 684.—HEYDEN, REITTER, AND WEISE, 1906, p. 126.—BERNHÄUER AND SCHUBERT, 1910, p. 5.—WINKLER, 1925, p. 323.—PORTA, 1926, p. 6.—PORTEVIN, 1929, p. 429.—SCHEERPELTZ, 1933, p. 993.—VAN DYKE, 1934, p. 177.

Trigonurus mellyi SCHAUM, 1849, p. 148.

DESCRIPTION.—(From various writers.) Shining black with head, last segment of abdomen and half of penultimate pale, labrum, mandibles, palpi, and antennae fulvous or rufescent. Head superficially punctulate; marked by a light frontal suture of a straight line, separating the flat triangular epistoma from the front; excavated behind the eyes with a transverse groove. Pronotum subdepressed; about a sixth less long than the widest of the posterior parts, a little narrower than the elytra at base; bisubsinuately truncate in front; subcurvilinear and rather feebly enlarged from the front posteriorly as far as the middle, parallel thence to base; the base truncate in a nearly straight line; posterior angles very pronounced, somewhat directed posteriorly and reposing in a small fossa of

the humeral angles of the elytra; narrowly bordered at the edges; longitudinally excavated with a broad channel at middle, gradually shrunk toward the apex and base, so that it does not or scarcely attains them; on each side of the sulcus with a broad longitudinal fossa, bordering on the external fourth of the base and anteriorly prolonged nearly to the middle of the length; densely punctate. Scutellum large, subparallel in the basal two-fifths, subcircular or broadly oval (arched) in the posterior three-fifths; punctate on the disk. Elytra a little more broad at the humeral angles than the pronotum at the posterior angles; subcurvilinearly enlarged from the base to a fifth of the length, subparallel thence to the extremity; truncate posteriorly; elevated laterally at the edge rather narrowly; rim almost smooth, punctulate longitudinally along the edge, narrowed from front to rear and more distinct in the last fifth, terminated in a point; depressed or subdepressed above; each channelled by nine punctate striae, the punctures transversely oval, more feeble toward apex and upon the three external striae; intervals in part subcrenulated by the stria punctures; the first and ninth intervals enlarged from front to rear, the first seven, from the suture, elevated in feeble carinae gradually feebler to the base from the apex, the seventh abutting the humeral angle, the third external flat or nearly so; excavated in a longitudinal fossa on the posterior fifth of the eighth stria. Prosternum strongly punctate on the posterior half, longitudinally strigulose in front; front coxae less enclosed behind but more covered at the sides than in *T. rugosus*. Mesosternum feebly carinate, very coarsely punctate. Metasternum convex, subdepressed and less strongly punctate at middle of disk; strongly punctate. Abdomen with retractile segment armed with very short and indistinct bristles and two rather distinct bristles; four last segments of the abdomen forming a triangle directed to the rear; venter convex, more obsoletely punctate or almost smooth on the median area, with first four segments finely bordered apically and subimpressed on the edges; the fifth concave at apex, the sixth subtruncate; prebasal piece finely chagreened, sparsely and obsoletely punctate, a little rufescent anteriorly. Legs moderate; trochantin of front coxa very distinctly visible; tibia finely and shortly pubescent, in part; tarsus pilose, more densely beneath, the posterior longer, ♂ anterior tarsus distinctly dilated. Length, 5 to 6 mm. Width, 2.1 mm.

TYPE LOCALITY.—"A la grande Chartreuse," France.

TYPES.—In either the Institut Ste. Marie at Chamond or the Musée d'Histoire Naturelle in Lyon.

RECORDS.—The following are the records known to me:

FRANCE: Various localities in the

Maritime Alps, the Grande-Chartreuse Mountains near Lyon (Lacordaire, 1854; and later writers).

ITALY: Maritime Alps (Porta, 1926).

REMARKS.—Notes on this species will be found under "Remarks" on the genus. I have examined briefly one example in the British Museum and have incorporated my observations in the above description.

Trigonurus asiaticus Reiche

Trigonurus mellyi Mulsant, Acbé, 1850, Bull. p. xxii.—Reiche, 1865, p. 642. (Misidentification.)

Piestus asiaticus Montandon MS.—Reiche, 1865, p. 642.

Trigonurus asiaticus Reiche, 1865, p. 642.—Solsky, 1868, pp. 161, 163, Pl. IV, figs. 3, 3a-e.—Favvel, 1872, pp. 17, 18.—Favvel, 1878, p. 186.—Mulsant and Rey, 1878, p. 216.—Heyden, Reitter, and Weise, 1906, p. 126.—Bernhauer and Schubert, 1910, p. 5.—Winkler, 1925, p. 323.—Van Dyke, 1934, p. 177.

DESCRIPTION.—(From various writers.) Form as in *T. mellyi*, elliptical, depressed; piceous black, glabrous, pronotum and elytra opaque, rest shining; head nigropiceous but rufopiceous in front; mouth, antennae, legs, and margins and apex of abdomen rufopiceous. Head small, much narrower than pronotum, convex; transversely sulcate behind the eyes; the frontal suture distinct; clypeus deeply longitudinally impressed at sides, feebly at center; finely sparsely punctate, the front between the eyes rather profoundly bi-impressed, subgibbous at middle; eyes moderately prominent; antennae longer than head and pronotum, scarcely incrassate apically, segments subcylindrical, third almost one-half longer than second, the rest subequal, the last oblong-ovate, acuminate. Pronotum broad, transverse, scarcely narrower than elytra, sides feebly rounded, subsinuate before the base, in front a little more narrowed than toward the base, posterior angles right, anterior rotund, base truncate, scarcely subtrisinuate, apex a little sinuate; dorsum deplanate, densely but less deeply punctate, finely rugulose; the middle with a feeble longitudinal impression evanescent slightly before base and apex; at sides with deep longitudinal impressions abbreviated a little behind the middle. Scutellum large, triangular, strongly punctate, opaque. Elytra almost twice as long as pronotum, base truncate, sides feebly rotund, apex a little more narrowed than base, sides and humerus narrowly reflexo-marginate, apex singly rotundato-truncate; dorsum deplanate in front, a little convex; feebly longitudinally impressed behind scutellum near suture on both sides; rugulose, opaque; punctatostriate, striae and punctures a little irregular, the latter somewhat deep; the intervals feebly convex, the third a little more elevated,

the seventh carinate from the humeral callus beyond the middle. Prosternum rugulose, subopaque, somewhat deeply variably less densely punctate, medially smooth before the anterior coxae, punctures less dense than at sides, transversely plicate. Mesosternum medially longitudinally carinate. Metasternum large, densely punctate, feebly transversely undulate. Abdomen almost as wide as elytra, gradually attenuate toward apex; first dorsal segments finely sparsely punctulate, last segment smooth; first ventral at sides strongly rather densely, at middle finely sparsely punctate, second sparsely at sides, at middle almost smooth, rest almost impunctate. Length, 5 to 6 mm.; width, 2 to 2 1/4 mm.

TYPE LOCALITY.—"De Batoum. Immeretie."

TYPES.—Probably in the Musée National d'Histoire Naturelle, Paris.

RECORDS.—The following are the records known to me:

CAUCASUS: (Aubé, 1850, as *mellyi*; Lacordaire, 1854, as *mellyi*; Solsky, 1868; Fauvel, 1872; Bernhauer and Schubert, 1910; Van Dyke, 1934); Batum (Reiche, 1865).

REMARKS.—Notes on this species will be found under "Remarks" on the genus. I have seen no examples and do not know definitely where any are to be found.

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NEW SPECIES OF NEOTROPICAL HESPERIIDAE (LEPIDOPTERA: RHOPALOCERA)

By E. L. BELL

The insects which form the basis of the following descriptions are all contained in the type collection of The American Museum of Natural History.

Atrytone ricana, new species

Figure 1

MALE.—Upper side brown. Primaries with dark fulvous scales and hairs in the basal area; a small bright fulvous spot in the lower part of the cell near the apex; three fulvous subapical spots; a narrow discal band of five slightly paler fulvous spots, two in interspace 1, somewhat triangular and almost touching each other in the center of the interspace, a larger spot in interspace 2, one each in interspaces 3 and 4, that in 4 small. Fringes concolorous. No stigma. Veins of these wings slightly darker.

Secondaries with dark fulvous hairs in and below the cell, which cover a small fulvous spot in the cell. A discal band of four small bright fulvous spots. Fringes fulvous.

Beneath: Primaries with the costal, apical and outer marginal areas to vein 2 sordid yellowish fulvous, the rest blackish brown; the discal band repeated paler, the spot in the cell repeated and the subapical spots are repeated but barely contrast with the pale yellowish fulvous. Secondaries sordid yellowish fulvous; the discal band repeated but barely visible; outer marginal area slightly darker.

Above the palpi and head are fulvous, the head with a greenish reflection; body dark brown with fulvous hairs. Beneath the palpi are pale fulvous; pectus fulvous; thorax with fulvous hairs; abdomen whitish. Antennae black above, beneath fulvous, each joint narrowly edged with dark brown, the club fulvous, apiculus red.

EXPANSE.—30 mm.

TYPE MATERIAL.—Holotype male, Villarrica, Paraguay.

Resembles *mella* Godman in the shape of the wings but is a much darker insect due to the reduced fulvous areas.

Atrytone nayana, new species

Figure 2

MALE.—Upper side. Primaries with a broad outer marginal dark brown band; an irregular

spot of the same color extending outwardly from the apex of the cell; the rest of the wings bright fulvous which extends along each vein into the dark outer marginal border. The veins are blackish brown. The fringes fulvous and brown becoming darker toward the apex of the wings. There is no stigma.

Secondaries above vein 8 pale brown; between veins 7 and 8 dark brown; interspace 6 mostly dark brown but with some fulvous in the center; a dark brown outer marginal border to the anal angle; all the rest of the wings bright fulvous. All the veins from 2 upward are blackish brown. Fringes fulvous.

Beneath paler than above. Primaries with a narrow black bar at the end of the cell; the base of the cell and interspace 1, the inner margin below vein 1, an outer marginal spot in interspace 1, and a submarginal spot in interspace 2 are all dark brown. All the rest pale fulvous. Secondaries with a hazy discal band of small paler spots.

Top of head, palpi and body bright fulvous. Beneath palpi, pectus and thorax bright fulvous; abdomen grayish white. Antennae above narrowly blackish, base of the club ringed with fulvous; beneath fulvous, spotted narrowly with black at the joints, the club fulvous, apiculus red.

EXPANSE.—25 mm.

TYPE MATERIAL.—Holotype male, Nayarit, Mexico.

This species resembles *Atrytone eulogius* Ploetz (*mellona* Godman) but it lacks the dark stripe along vein 2 of the upper side of the primaries and the fulvous area of the secondaries is more extended. The form of the male genitalia differs from that of *eulogius* in the termination of the claspers.

Atrytone (?) *potesta*, new species

Figure 3

MALE.—Upper side of both wings dark brown and immaculate. Fringes of primaries concolorous, a little paler at the inner angle; of the secondaries slightly paler than the wings, especially at the anal angle. There is no stigma.

Beneath dark brown. Primaries with a somewhat lunate pale yellowish spot in the basal third of interspace 2, the outer edge of which is

not sharply defined; a large wedge-shaped spot of the same color in interspace 1, broad externally and tapering inwardly. Secondaries with a very small whitish spot at about the center of the apex of the cell; a discal band of five spots, the lower one the larger and pale yellow; the next one above smaller and the same color; the next three very small and whitish.

Top of head, palpi, collar and shoulder covers dark brown and fulvous; body dark brown. Beneath palpi grayish; pectus grayish brown; thorax dark brown; abdomen yellowish white with a broad brown central stripe. Antennae above black; beneath blackish, the club and just below it pale yellow.

EXPANSE.—30 mm.

TYPE MATERIAL.—Holotype male, Iquitos, Peru.

This species may not be strictly congeneric with the others in the genus but it seems closely related. In superficial appearance it does not greatly resemble any other of the described *Atrytone* species.

Rhinthon iquita, new species

Figure 4

MALE.—Upper side dark brown. Primaries with a small semihyaline subapical spot in interspace 6; a small, quadrate hyaline spot in the basal quarter of interspace 3; a vertical hyaline bar, a little constricted in the center, in interspace 2. A narrow stigma lying along the upper side of the basal half of vein 1, completely covered by long brown hairs. Fringes concolorous.

Secondaries immaculate; fringes a little paler than the wings.

Beneath a little paler brown than above. Primaries with the spots of the upper side repeated but the subapical spot is very indistinct. Secondaries with two very minute, ill-defined pale dots between veins 2 and 4.

Top of head, palpi, collar and shoulder covers greenish. Body above brown. Beneath palpi grayish; pectus light brown with a green reflection; thorax grayish brown; abdomen grayish with a dark central line. Antennae black above; beneath brownish, the club and just below it yellow.

EXPANSE.—30 mm.

TYPE MATERIAL.—Holotype male, Iquitos, Peru.

This species resembles *Rhinthon cynea* Hewitson and *bistrigula* Herrich-Schaeffer but is smaller than either of them and from *cynea* it differs in lacking the whitish area at the inner angle of the primaries beneath; and from *bistrigula* in having the quadrate spot in interspace 3 of the upper side of the primaries farther removed out-

wardly from the spot in interspace 2. From both *cynea* and *bistrigula* it differs in the details of the male genitalia.

Vistigma zara, new species

Figure 5

MALE.—Upper side of both wings brown. Primaries with the costal margin from base to end of the cell bright yellow with a brown streak in the middle; a small orange-yellow spot near the upper corner of the apex of the cell; three elongate orange-yellow subapical spots, the lower one the longer, the middle one extending a little basad of the other two; a short, narrow, bright yellow inner marginal streak extending outward from the base; a discal band of six spots, the first narrow, elongate, bright yellow lying on vein 1 and connected with the base of the wing by a streak of similarly colored scales, the next spot just above the outer corner of the previous spot and under vein 2, very small and bright yellow; the next spot larger, subquadrate, same color, in interspace 2; the next spot smaller, slightly elongate, in interspace 3; then two small orange-yellow spots, one each in interspaces 4 and 5. The fringes are paler than the wings and become whitish at the inner angle and are feebly checkered from vein 2 upward. The stigma is very indistinct and is composed of a V-shaped part in the base of interspace 2 and a horizontal bar just under vein 2.

Secondaries with a discal band of five orange-yellow spots between veins 2 and 7, the one between veins 4 and 5 is elongate and extends outward from near the end of the cell, the one between veins 5 and 6 is also elongate and inwardly begins at about the outer third of the previous spot and extends farther outward toward the outer margin of the wing, these two spots are nearly fused where they parallel each other, which gives the appearance of one very long stripe, the one spot above and two below are very much smaller. Fringes yellowish white and feebly checkered from vein 2 upward.

Beneath: Primaries with costal margin and apical area yellowish brown; the veins yellow beyond the discal band from vein 2 to the apex; a fine black marginal line; the rest of the wings blackish brown. Spots of the upper side repeated and bright yellow except the large spot just above vein 1 and the two yellow streaks, which are absent. Secondaries yellow-brown, all the veins yellow from vein 1 upward. Spots of the upper side repeated and bright yellow and an additional spot between veins 1 and 2 and another between veins 7 and 8. Abdominal fold blackish brown with a light overscaling of sordid yellowish, the inner margin yellow-brown. The fringes at the anal angle and along inner margin are yellow.

Top of head and body greenish yellow. Beneath the palpi and pectus are yellow, thorax with greenish-yellow hairs, abdomen white with a heavy blackish-brown central line. Legs

yellow-brown. Antennae above black, beneath brown, the club yellow.

EXPANSE.—30 mm.

TYPE MATERIAL.—Holotype male, Santa Cruz, Bolivia.

Zara is a little smaller but otherwise quite similar to *Phlebodes tiberius reticulata* Ploetz, differing on the upper side of the primaries in having the cell spot, and the spots of the discal band more separated, on the secondaries in the more separated spots of the discal band. On the under side the ground color of the wings is quite different from that of *reticulata*. The male stigma is of quite different form from that of the genus *Phlebodes*.

Papias larias, new species

Figure 7

MALE.—Upper side both wings brown and immaculate. Fringes concolorous, slightly paler at the tip.

Beneath brown. Primaries with three small, indistinct, paler spots, of which two are subapical and one near the middle of interspace 3. Inner margin and outer half of interspace 1 paler. Secondaries with a hazy indication of a discal band of paler spots.

Top of head and palpi dark brown and fulvous; body dark brown. Beneath palpi fulvous and brown, pectus and thorax fulvous brown. Antennae missing.

EXPANSE.—28 mm.

TYPE MATERIAL.—Holotype male, St. Laurent, French Guiana.

Slightly smaller than *Papias phainis* Godman and with different genitalia.

Mnasalcas (?) *colomus*, new species

Figure 6

MALE.—Upper side of both wings dark brown. Fringes concolorous. Stigma on the primaries heavily developed and somewhat darker brown than the wings, consisting of a stripe bordering the cell from the rise of vein 3 to near the angle formed by the rise of vein 2 and then bent directly downward to vein 2, immediately below and bordering vein 2 a squarish spot and below this a vertical bar extending to vein 1, this bar is slightly oblique from the base outwardly.

Beneath both wings paler brown than above. On the primaries the stigma of the upper side is distinctly shown in black scales. In interspace 1 beyond the black scales is a paler area and another smaller pale area at the anal angle. The secondaries have a small yellowish spot in the end of the cell at the lower corner and traces of three similar but smaller spots in interspaces 2, 3 and 4.

Top of the head and body dark brown, be-

neath the pectus is dark fulvous brown, thorax and abdomen dark brown. Palpi missing. Below the eyes dark fulvous. Antennae long, black on both sides, beneath the basal half of the club and just below it fulvous.

EXPANSE.—Male 40 mm.

TYPE MATERIAL.—Holotype male, Colombia.

Colomus is a much larger insect than *Mnasalcas uniformis* Butler and Druce and the color of the wings is not so black, the secondaries are more produced at the anal angle and the stigma of the primaries does not fill the angle at the rise of vein 2.

Vehilius danius, new species

Figure 8

MALE.—Upper side brown with a violet sheen at certain angles. Primaries with a few sordid yellowish scales representing subapical spots in interspaces 6 and 7 and sometimes in interspace 8; a spot in the upper part of the apical third of the cell; discal spots in interspaces 2 and 3, all of these spots are very small, ill defined and indistinct. Fringes concolorous in the upper part, becoming paler at the tip in the inner angle area.

Secondaries immaculate. Fringes brown at the base, whitish at the tip.

Under side brown. Primaries with a violet sheen, especially prominent on the costal margin, apical area and outer margin above vein 2. Inner margin paler; an elongate pale spot in interspace 1 from the center towards the outer margin. Veins in the apical area yellow and a narrow yellow streak below the costal margin from the base to the end of the cell, which is absent in the paratype. The subapical spots are small but better defined and more yellow than above. The fringes are a little darker brown than the wings.

Secondaries brown with a pronounced violet sheen. All the veins are yellow. A discal band of five yellow spots between veins 2 and 8, and a narrow, yellow marginal line; yellow streaks between the veins connect with each one of the spots of the discal band. The abdominal fold overscaled with yellow. Fringes dark brown at the base and sordid whitish in the outer half.

Top of the head black with some sordid yellowish scales in the center, the eyes bordered with bright yellow. Top of palpi black and yellow. Tegulae and base of thorax with yellowish-brown hairs. Beneath the palpi are whitish; the pectus whitish; thorax sordid whitish; abdomen pale yellowish brown to whitish. Antennae black on both sides, a narrow yellow ring at the base of the club; the club yellow beneath.

FEMALE.—Similar to the male

EXPANSE.—Male, 24 to 26 mm.; female, 28 mm.

TYPE MATERIAL.—Holotype male, allotype female and one male paratype, Massaranduba-Blumenau, Santa Catharina, Brazil.

Danius is smaller than *Vehilius scheria* Ploetz which it somewhat resembles on the upper side, although *scheria* lacks the indistinct spots of the primaries. On the under side *scheria* does not have the yellow veins and streaks and the violet sheen is less deep in color.

***Vehilius madius*, new species**

Figure 9

MALE.—Upper side of both wings brown. Primaries with eight opaque yellow spots, three subapical, the lower of which is the larger; two in the cell near the apex, the upper one elongate, the lower one much smaller and roundish; three discal in interspaces 1, 2 and 3, the lower one small and somewhat triangular, lying on vein 1, the one in interspace 2 elongate and oblique, slightly excised on the outer side, the one in interspace 3 longer than wide. Some yellow hairs on the basal half of the costal margin and below vein 1 near the base. Fringes concolorous, a little paler at the tip.

Secondaries with indistinct yellowish spots, one in the end of the cell and three in the form of a discal band. Fringes as on the primaries.

Beneath brown. The primaries with a bright yellow costal streak from the base to vein 11; a yellow streak between each vein from there to vein 2, those between veins 6 and 8 extending inwardly to the subapical spots, the streak between veins 5 and 6 is very long and extends through the center of the cell for about two-thirds its length; below vein 2 there is a narrow yellow marginal line. All of the spots of the upper side are repeated a little larger and bright yellow, the spot in interspace 1 is paler and diffuse.

Secondaries with a yellow marginal line extending from the base of the wings to the anal angle. All the veins are yellow in whole or in part; between the abdominal fold and vein 8 there is a yellow streak in each interspace which extends inwardly to the spots of the discal band; the streak below vein 6 extends entirely through the center of the cell to the base of the wings; the three discal spots and the cell spot of the upper side are repeated, larger, better defined and bright yellow and in addition there are two more spots above and one below in the discal band. The abdominal fold is lightly overscaled with yellow.

Top of head, palpi and collar yellow and black; shoulder covers and tegulae sordid yellowish with a slight green reflection; thorax and abdomen brownish. Beneath palpi yellow and black; thorax yellow; abdomen yellowish white. Antennae black above; beneath black with some yellow scales, the club yellow.

EXPANSE.—28 mm.

TYPE MATERIAL.—Holotype male, Massaranduba-Blumenau, Santa Catharina, Brazil.

In the spotted appearance of the upper

side *madius* most nearly resembles *Vehilius venosus* Ploetz but the middle spot of the discal band of the primaries is taller than wide and in *venosus* it is the reverse of this, and on the under side *venosus* lacks the streaks between the veins and the color of the maculation is paler.

***Vehilius putus*, new species**

Figure 10

MALE.—Upper side of both wings dark brown. Fringes slightly paler, especially at the anal angle.

Beneath both wings dark brown. Primaries with all the veins below the costal margin, at the apex and outer margin to vein 2 bright yellow and a pale stripe above and one below vein 1 in the outer half of the wings. A narrow, dark outer marginal line. Secondaries dark brown with a purple tint except in the abdominal fold. All the veins are bright yellow. A marginal band of small yellow spots between the veins and a curved discal band of from three to five similar spots, all of which tend to be somewhat elongate. Fringes paler than above, becoming yellowish along the inner margin.

Top of head and palpi blackish brown with yellow dots. Thorax dark brown with some yellowish hairs at base of tegulae and in the shoulder covers; abdomen dark brown. Beneath the palpi are yellow fulvous with some black hairs; the outer sides of the palpi are bright yellow narrowly edged with black and there is a bright yellow spot under the eyes. Pectus fulvous brown, thorax grayish brown; abdomen pale brown with a dark brown central stripe. Antennae black on both sides, the apiculus and base of the club beneath yellow.

EXPANSE.—28 to 30 mm.

TYPE MATERIAL.—Holotype male and three male paratypes, Putumayo River region, Peru.

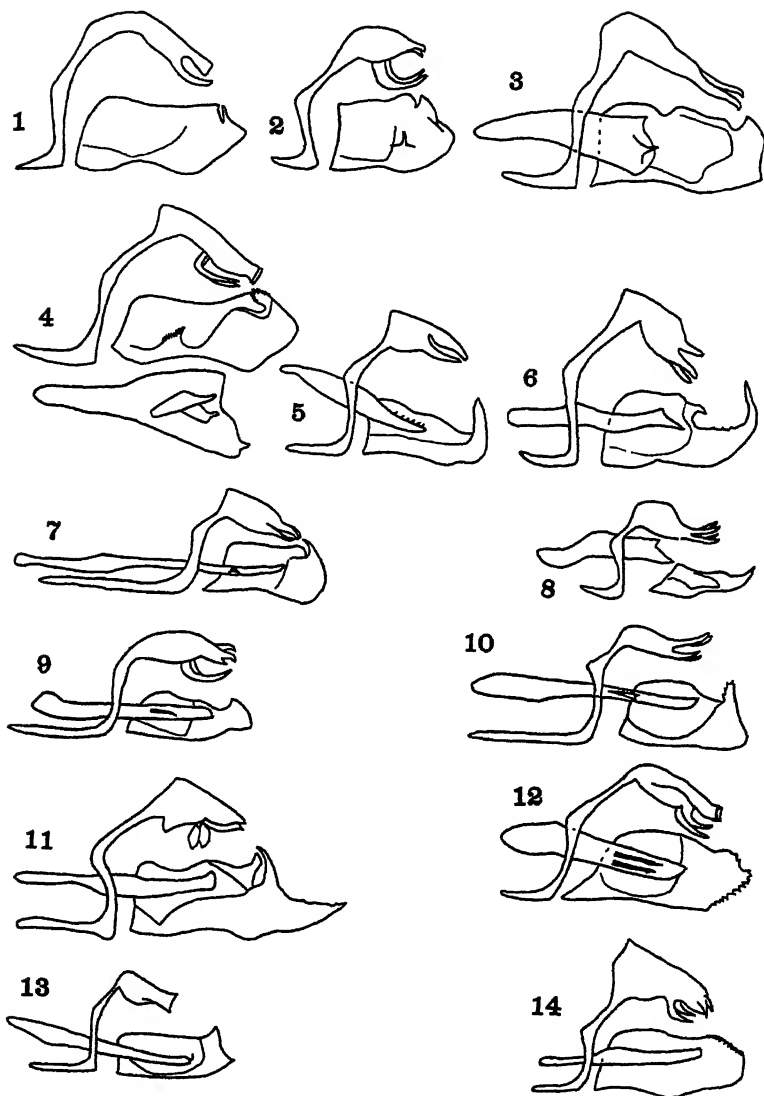
Putus is somewhat larger than *Vehilius venosus* Ploetz and lacks the maculation of the upper side of the wings.

***Lerodea schwarzi*, new species**

Figure 11

MALE.—Upper side blackish brown. Primaries with from two to three small orange fulvous subapical spots, sometimes only the lower one really distinct; a rather narrow discal band of five similarly colored spots, two of which are in interspace 1 and may be partly fused into what appears to be one irregular spot, the upper spot in interspace 4 is very small. Rusty fulvous overscaling in the basal half of the costal margin. Fringes orange fulvous, from vein 2 to the apex intermixed with dark brown. There is no stigma.

Secondaries with a rather broad discal band of four orange fulvous spots of which the one between veins 4 and 6 is the longer. Basal area



Figs. 1 to 14. Male genitalia.

and along abdominal fold with long rusty fulvous hairs. Fringes orange fulvous.

Beneath: Primaries with the subapical spots repeated and those three of the discal band lying between veins 2 and 5, and sometimes a slight indication of the upper edge of the upper spot in interspace 1. The ground color is blackish brown, overscaled with rusty fulvous broadly along the costal margin, apical area and outer margin to vein 2 and sometimes narrowly from there to the inner angle. Secondaries rusty fulvous, the discal band of the upper side re-

peated in a little paler color; at the end of the cell an ill-defined darker spot.

Upper side of head and body blackish with rusty fulvous hairs. Beneath palpi and pectus fulvous with some black hairs; thorax sordid fulvous brownish; abdomen fulvous. Antennae black above with some fulvous scales, especially at the base of the club; beneath fulvous a little spotted with black below the club.

FEMALE.—Similar to the male. The abdomen beneath blackish brown.

EXPANSE.—Male, 26 mm.; female, 28 mm.

TYPE MATERIAL.—Holotype male, allotype female, one male and one female paratype, near Cali, Western Cordillera, Colombia; one male paratype, road from Queremal to Buenaventura, Western Cordillera, Colombia. These specimens were collected at altitudes ranging from 3500 to 6500 feet.

This species is named for Mr. Herbert F. Schwarz, who, with Mr. E. I. Huntington, collected the specimens.

Schwarzi has very much the same form of the male genitalia as that of *Lerodea noctis* Ploetz, differing in slight details, and it also differs from that species in that the primaries are a little less apically pointed and the secondaries less produced at the anal angle. On the upper side of the wings the maculation is much more extensive and deeper orange fulvous than in *noctis* and on the under side entirely different.

Lerodea remea, new species

Figure 12

MALE.—Upperside of both wings brown. Primaries with five spots, two very small ones subapical, ill defined and indistinct, formed by a few yellowish scales; a small indistinct yellowish spot just above vein 1 near the middle; an oblique, somewhat oblong spot between veins 2 and 3; a small roundish spot above it in interspace 3, these last two spots are pale yellowish white and semihyaline. Costal margin bordered with dark fulvous to nearly the apex of the wings. Fringes paler than the wings.

Secondaries immaculate, with long yellowish hairs along the abdominal fold. Fringes as on the primaries.

Beneath a little paler than above. The three discal spots of the primaries are repeated, that in interspace 1 larger, whitish and diffuse. Secondaries with a light overscaling of sordid whitish. Both wings have a narrow, dark marginal line.

Head, palpi and body above with fulvous and fulvous brown hairs. Beneath palpi, pectus and thorax are fulvous brown, abdomen grayish brown. Antennae missing except a short piece and this is narrowly black above and ringed with yellow; beneath yellow, edged with black at each joint.

EXPANSE.—31 mm.

TYPE MATERIAL.—Holotype male, New Bremen, Santa Catharina, Brazil.

On the upper side of the primaries *remaea* somewhat resembles *Lerodea tripunctus* Herrich-Schaeffer but the subapical spots are less distinct and the upper two discal spots are larger; on the under side of the secondaries there is no trace of the discal band found in *tripunctus*.

Parphorus nemorus, new species

Figure 13

MALE.—Upper side blackish brown. Primaries with two minute subapical spots in interspaces 6 and 7 and a trace of one in interspace 8; a discal band of four bright yellow spots, a small one in interspace 1, a larger, somewhat elongate one in interspace 2, a small one in interspace 3, a very minute one, barely discernible without a lens, in interspace 4; a few fulvous scales along the costal margin from the base to the end of the cell. The usual form of the male stigma. Fringes paler than the ground color.

Secondaries with a hazy discal band of four small dull fulvous spots. Along abdominal fold with long dull fulvous brown hairs. Fringes sordid whitish.

Beneath: Primaries along the costal margin and in the apical half dull fulvous brown, the rest of the wings blackish brown. Veins in the apical area slightly paler. The subapical spots are faintly repeated; the discal spots in interspaces 2 and 3 are repeated and bright. Secondaries dull fulvous brown, the veins slightly paler; the discal band dimly repeated.

Top of head, palpi and thorax brown intermixed with dull fulvous with a slight greenish reflection. Beneath palpi and pectus fulvous and black; thorax dull fulvous; abdomen whitish. Antennae black above; beneath spotted with yellow, the club yellow below the apex.

EXPANSE.—24 mm.

TYPE MATERIAL.—Holotype male, New Bremen, Santa Catharina, Brazil.

This species is similar to *Parphorus storax* Mabille but differs on the upper side in the darker ground color and in the spots of the discal band of the primaries being better defined and more separated and on the secondaries having the faint discal band of spots. On the under side in the dull fulvous ground color and in the veins being only slightly paler and not prominently yellow as in *storax*.

Carystus klugi, new species

Figure 14

MALE.—Upper side dark brown. Primaries with a small ovate subapical spot in interspace 6 and a very tiny dot above it in the type but missing in the paratype; a discal band of three spots in interspaces 1, 2 and 3, the spot in interspace 1 is yellow, the others yellowish white and semihyaline; a yellow inner marginal stripe below vein 1 from under the lower spot of the discal band to near the base of the wing. Fringes concolorous, slightly paler at the inner angle.

Secondaries with a straight, narrow discal band of six yellow spots barely separated by the veins. Fringes slightly paler brownish, a little tinged with yellowish at the anal angle.

Beneath: Primaries paler brown and a still paler area beyond the end of the cell. Spots of the upper side repeated, the one in interspace 1 white, and another small white spot under the discal spot in interspace 2. Secondaries brown in the basal half of the costal margin; a broad marginal brown band, widening from the outer angle to the abdominal fold; an indefinite and irregular brown discal band; a brown bar at the end of the cell; all the rest of the wings white except the extreme anal angle area, which is suffused with pale brown.

Top of head, palpi and thorax dark fulvous brown; abdomen brown. Beneath palpi, pectus and thorax grayish white; abdomen sordid whitish. Antennae black, beneath with some grayish scales at the base of the club and on the apiculus.

EXPANSE.—35 mm.

TYPE MATERIAL.—Holotype male and one male paratype, Iquitos, Peru.

This species is named for Mr. G. Klug, of Iquitos, Peru.

Klugi is of the size and general appearance of *Carystus artona* Hewitson, differing on the upper side of the primaries in lacking spots in the cell and in the larger discal spots. On the secondaries in the spots of the discal band being yellow, larger and very close together. On the under side the maculation is entirely different from *artona*.

Callimormus igarapus, new species

Figure 16

MALE.—Upper side brown. Primaries with two small, ill-defined, pale yellowish subapical spots in interspaces 6 and 7 and sometimes a trace of another one in interspace 8; a minute yellowish dot in the lower corner of the apex of the cell, absent in some individuals; a discal band of three small spots, yellowish white to orange-yellow, the upper one a small streak in the base of interspace 3, the next below subquadrate, the lower one elongate and ill defined. An indistinct V-shaped stigma in the base of interspace 2. Fringes paler brown, sometimes becoming whitish at the tip.

Secondaries with a discal band of three or four ill-defined pale spots. Fringes whitish, mixed with pale brown.

Beneath: Primaries brown, apical area and a little below it paler. The spots of the upper side are repeated paler, except that on vein 1 and sometimes there is a trace of that one. A few yellowish scales in the basal half of the costal margin. A dark outer marginal line. Secondaries with a rather broad, pale brown outer marginal band unevenly overscaled with grayish, followed inwardly by a discal band of grayish spots beginning between veins 7 and 8 and ending on the abdominal fold, and somewhat angled opposite the end of the cell. The area

between the discal band and the base of the wings is brown, unevenly overscaled with grayish except immediately behind the discal band, where a spot-like band of brown is left without the overscaling. The gray overscaling is heavily accumulated at the end of the cell, producing a narrow, ill-defined gray bar; and sometimes there is a heavy accumulation at the lower spot of the discal band, extending this spot along the abdominal fold to the margin of the wing. The unevenness of the gray overscaling produces a very mottled appearance to the basal half of these wings.

Top of head and palpi grayish brown with some fulvous hairs; body brown. Beneath the palpi are grayish white with some black or brownish hairs; pectus whitish; thorax grayish; abdomen whitish, becoming yellowish white at the anal end, and with or without a thin brown central line. Antennae black above; beneath spotted with yellow, the club pale yellow, the apiculus red.

FEMALE.—Similar to the male, the spots of both wings smaller.

EXPANSE.—Male, 20 to 22 mm.; female, 19 mm.

TYPE MATERIAL.—Holotype male, Santos, Brazil; allotype female, Igarapi-Assu, Para, Brazil. Three male paratypes: Santos and Igarapi-Assu, Brazil; Georgetown, British Guiana. One female paratype, Bartica, British Guiana.

This species resembles *Callimormus corades* Felder but differs on the upper side in having the spots of the primaries smaller and paler and in having a distinct discal band on the secondaries. On the under side in the reduced yellow overscaling on the basal half of the costal margin of the primaries and in the very mottled appearance of the secondaries.

Callimormus corus, new species

Figure 17

MALE.—Upper side dark brown. Primaries with a few yellow scales near the apex, which form hazy subapical spots in interspaces 7 and 8. An indistinct discal band formed of small accumulations of yellow scales in interspaces 1, 2 and 3. A small, indistinct stigma in the base of interspace 2. Fringes slightly paler than the ground color, becoming sordid whitish at the tip at the anal angle.

Secondaries with dull fulvous hairs over the disc and along the abdominal fold. Fringes sordid whitish.

Beneath paler brown. Primaries with the veins in the costal and apical areas narrowly sordid yellowish. Secondaries with the veins narrowly sordid yellowish and the entire wings sparsely covered with sordid yellowish scales, which ac-

cumulate to form a discal band of small hazy spots.

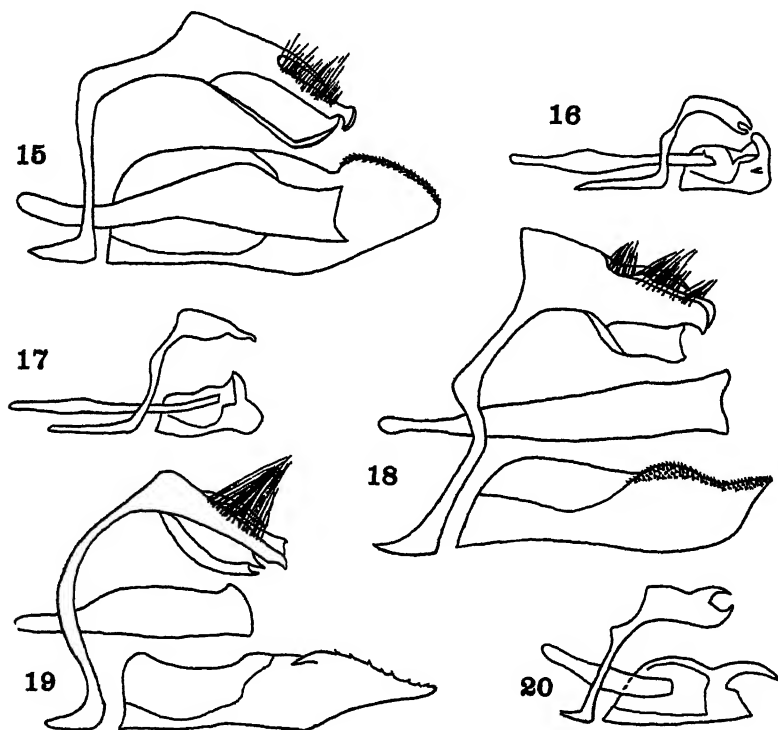
Head, palpi and body above brown with dull fulvous hairs. Beneath the palpi are sordid whitish and black hairs intermixed. Pectus, thorax and abdomen sordid whitish. Antennae above black, beneath minutely spotted with fulvous, the basal half of the club yellowish.

EXPANSE.—22 mm.

TYPE MATERIAL.—Holotype male, Para, Brazil.

On the upper side *corus* greatly resembles *Callimormus gracilis* Felder but differs

extends from the base of the wings through the cell and merges with the beginning of the marginal black band, this band entirely fills the cell, except a small brighter fulvous spot opposite the base of interspace 3, and extends a little beyond the apex in interspaces 4 and 5, and below the cell in the extreme base of interspace 2 and just below it in the upper half of interspace 1. The disc of the wings is bright fulvous from interspace 6 to the inner margin, the part between interspaces 4 and 6 is much narrower than the rest and the spot in interspace 6 extends a little inward of those below it so the band gives the



Figs. 15 to 20. Male genitalia.

beneath in the less prominently yellow veins of both wings and in the yellow over-scaling of the secondaries.

Mnestheus zareus, new species

Figure 20

MALE.—Upper side of primaries with the costal margin rusty fulvous as far as the end of the cell, from there a black marginal band begins and extends all the way around the apex and outer margin to the inner angle, widening a little from the apex downward. Another black band

appearance of being hooked at the top. The fringes are darker fulvous. The stigma is inconspicuous and consists of two small stripes, one lying along vein 2 in the base of interspace 2 and the other immediately below it on the under side of vein 2, both of the stripes lie in the downward extension of the black band which passes through the cell.

Secondaries black with an oblong, fulvous discal band and a small fulvous spot in the end of the cell, which is almost fused with the discal band. A narrow stripe of somewhat darker ful-

vous hairs along the edge of the abdominal fold. Fringes fulvous.

Beneath: Primaries black at the base below the costal margin, also inner margin narrowly, outer margin broadly from inner angle to vein 2, a spot in interspace 2 not reaching the margin and a few scales above it in interspace 3, an irregular spot just beyond the apex of the cell. The discal band and cell spot repeated bright fulvous, the cell spot larger. Costal margin, apical area and outer margin to vein 2 reddish fulvous. Secondaries reddish fulvous with an indefinite suggestion of the discal band of the upper side. Abdominal fold black, except along the inner margin, and with a slight overscaling of reddish fulvous. Fringes at anal angle somewhat paler than those above it.

Top of head, palpi and thorax reddish fulvous, abdomen paler fulvous. Beneath, the palpi and pectus fulvous and reddish fulvous. Thorax reddish fulvous, abdomen yellowish fulvous. Antennae black above, beneath yellow, on the sides spotted with yellow.

FEMALE.—Similar to the male, the fulvous areas reduced and on the secondaries the small spot in the end of the cell is missing.

EXPANSE.—Male, 29 to 32 mm.; female, 32 mm.

TYPE MATERIAL.—Holotype male, allotype female and one male paratype, Joinville, Santa Catharina, Brazil.

This insect is similar in superficial appearance to *Padraona krezos* Ploetz as figured by Draudt (in Seitz, 1924, Macrolepidoptera of the World, V, plate 183e) but differs on the upper side in that the discal band of the primaries does not extend so near to the costal margin and is much wider from vein 4 downward and on the under side of these wings in that the black outer marginal band at the inner angle does not follow the margin above vein 2 but turns inward, and the veins in the apical area are not yellow. On the secondaries beneath the veins are not yellow and the abdominal fold is black except along the abdominal margin.

Talides alternata, new species

Figure 15

MALE.—Upper side of both wings rufous brown. Primaries with outer margin a little rounded; secondaries broad and outer margin prominently rounded.

Primaries with eight yellow hyaline spots as follows: four subapical, elongate, the lower the larger and placed a little outward of those above it, the upper in interspace 9 smaller than the others; a large one in the cell near the apex, slightly constricted in the middle; a discal band of three, the lower one very small on vein 1 a

little beyond the center, one vertical extending across interspace 2 just beyond the stigma, broader at the bottom than at the top, thus somewhat triangular in shape; a subquadrate one in interspace 3. Costal margin broadly ferruginous in the basal half, this color extending over the basal third of the wings and along a little more than half of the inner margin. The fringes ochraceous, purely so at the inner angle and a little suffused with brownish above it to the apex. The usual gray stigma of the genus.

Secondaries with a very small yellow hyaline discal spot beyond the end of the cell. Basal area with ferruginous hairs. Fringes broad and entirely bright ochraceous.

Beneath the primaries with the costal margin and upper half of the cell, all of the apical area and downward along the outer margin reddish; all the rest brown except a diffuse yellow area around the small hyaline spot on vein 1; a marginal band of lilacine scales from the apex to vein 2. All of the hyaline spots repeated and a small yellow spot just above the cell spot. Fringes as on the upper side but with a narrow, brown subterminal line. Secondaries reddish, with an irregular discal band, but slightly darker than ground color and very indistinct, which extends around the cell and toward the base of the wings, above the end of the cell it is extended upward to the costal margin in a narrow line and toward the base again extended upward to vein 8. A narrow dark brown marginal line from vein 7 to vein 2, which is internally bordered by a narrow line of lilacine scales. The hyaline discal spot is repeated. Abdominal fold brown. Fringes at anal angle bright ochraceous, above there darker ochraceous suffused with brown and in this area with a narrow brown subterminal line.

Top of head, palpi and thorax ferruginous, abdomen ferruginous brown, anal tuft ochraceous. Beneath the palpi, pectus and thorax are ferruginous, abdomen ochraceous. Antennae above black, beneath black spotted with yellowish brown and the apiculus that color.

EXPANSE.—60 mm.

TYPE MATERIAL.—Holotype male, Santa Catharina, Brazil.

Alternata resembles *sinon* Cramer (*sergestus* auct.) and has about the same rounded wing shape as the female of that species. It differs from the male *sinon* in the much broader wings and their rounded outer margins; in the ground color of the wings being a more rufous brown; in the four hyaline subapical spots of the primaries (of the ten males of *sinon* at hand only one shows a very small subapical spot in interspace 9 and it is not hyaline); in the small hyaline spot of the discal band on vein 1 (only one of the series of male *sinon* above referred to has

a small spot in this position and it is not hyaline); in the upper spot of the discal band, in interspace 3, being far removed outwardly from the triangular spot in interspace 2, whereas in all of the *sinon* males at hand these two spots are close together; in the fringes being more deeply ochraceous and those of the secondaries much broader; and in the anal tuft of the abdomen being ochraceous. The under side is similar in color to some individuals of *sinon* but there is so much variation and the maculation of the secondaries is often so diffuse and indistinct that a comparison seems of little use.

Alternata differs from *sergestus* Cramer (*adjuncta* Ploetz) in being a little larger; with larger spots on the primaries; in having four instead of three subapical spots; in having the small discal spot on vein 1; in the ferruginous basal area of the wings and in the bright ochraceous fringes. On the under side the maculation of the secondaries is entirely different.

The form of the male genitalia is similar to that of *sinon* Cramer, differing in small detail in the termination of the claspers.

Godman, *Biologia Centrali-Americana*, III, plate 106, figure 24, illustrates the male genitalia of *sinon* (as *sergestus*) and in figures 25 and 26, the upper and under sides of a "variety" of *sinon* (as *sergestus* var.). The figure of the male genitalia shows a broad, truncate termination of the claspers and our examinations have shown that the termination may vary from this form to one that is gradually rounded upward. The figure of the upper side of the

"variety" shows a different disposition of the spots in interspaces 2 and 3 of the discal band of the primaries, between the right and left sides, a difference which may be due to artistic reproduction rather than a natural occurrence. The figure also shows four subapical spots, a spot on vein 1, and decidedly ochraceous fringes. *Alternata* differs from this figure in that the spot of the discal band of the primaries in interspace 3 is placed a little farther outwardly from that in interspace 2 than is shown on the right side of the figure; in the spot in interspace 2 being more triangular; in the spot on vein 1 being much smaller, as is also the discal spot of the secondaries. On the under side there is considerable similarity, differing on the primaries in the inner marginal spot of the discal band being not a sharply defined spot but a diffuse yellow area surrounding the small hyaline spot; on the secondaries in the small yellow spot between veins 6 and 7 in the figure being not present, and neither are the two darker spots of the figure. Also the fringes of the secondaries of *alternata* are broader.

For comparison with the genitalia of *alternata* a figure is given of the more rounded form of *sinon* clasper (Fig. 18) and also one of the genitalia of *sergestus* Cramer (Fig. 19), more commonly known as *adjuncta* Ploetz.

K. J. Hayward, 1939, *Physis* (Revista de la Sociedad Argentina de Ciencias Naturales), XVII, p. 301, has published a note correcting the usual misconception of *sinon* Cramer and *sergestus* Cramer.

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STUDIES OF PERUVIAN BIRDS. NO. XXXVIII¹

THE GENERA *OREOTRICCUS*, *TYRANNULUS*, *ACROCHORDOPUS*, *ORNITHION*,
LEPTOPOGON, *MIONECTES*, *PIPMORPHA*, AND *PYROCEPHALUS*

BY JOHN T. ZIMMER

I wish to record my obligations to Mr. Rodolphe de Schauensee and Mr. James Bond of the Academy of Natural Sciences of Philadelphia for the loan of certain critical material used in the following studies.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color Standards and Color Nomenclature."

Oreotriccus plumbeiceps (Lawrence)

Pogonotriccus plumbeiceps LAWRENCE, 1869, Ann. Lyc. Nat. Hist. N. Y., IX, p. 267—Bogotá, Colombia; U. S. Nat. Mus.; paratype in Amer. Mus. Nat. Hist.

Idma, 2 ♂, 1 ♀; Chaupe, 1 ♀.

Compared with a paratype and six other Colombian birds. The Idma specimens are very similar to the Colombian birds although they are very slightly duller or darker green on the back and have a little stronger tinge of pale grayish olive on the chest. The differences are too slight to give any assurance of taxonomic distinction in spite of the wide geographic hiatus in the ranges. Two birds from northern Ecuador are not appreciably different above from Colombian skins but are deeper yellow on the belly and more heavily shaded on the chest.

The Chaupe specimen, unfortunately not fully adult, differs from both Colombian and south-Peruvian series by much brighter green back (near Warbler Green instead of Serpentine Green) and slightly paler gray cap, although in other respects it agrees with the Colombian specimens. It is very

nearly adult, in full (not molting) plumage, but with the tail of immature texture and noticeably tipped with buffy whitish, and with the primaries and secondaries similarly soft at their tips and with the secondaries narrowly tipped with a pale border, sharper than in the adults. The pattern of wing-marking otherwise is like that of the adults. It is impossible to say whether the bright coloration of the back may not be due likewise to immaturity. Consequently, until more adequate material is available, any subdivision of the species is inadvisable.

There is a certain similarity of this species to *Pogonotriccus ophthalmicus* although the distinctions are easily seen. *P. ophthalmicus* has the back usually clearer green and the top of the head darker gray; the superciliary stripe is whiter and is formed by sharply defined subterminal bars on the feathers; the auriculars are basally yellower and terminally blacker; the upper wing-bar is more greenish and usually less sharply defined; the pale yellow portion of the outer margin of the inner tertial reaches only about halfway basad from the tip and usually is broader toward the tip although there is a greenish external border that may reach farther; the belly is more intensely yellow, the breast is more heavily suffused with green (rarely the upper belly, also), and the throat is more restrictedly whitish, with darker bases on the feathers. The mandible and feet are pale; the nostril is narrowed to a slit and is strongly operculate. *Oreotriccus plumbeiceps* has a duller back, paler cap, and grayer and more uniform superciliary stripe; auriculars more whitish basally and grayer distally;

¹ Earlier papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, 930, 962, 963, 994, 1042, 1043, 1044, 1045, 1066, 1065, 1108, and 1109.

pale yellowish outer margin of the inner tertial narrower distally and reaching nearly or quite to the base of the feather; sharper and yellower upper wing-bar; lighter and clearer yellow belly and breast; and broader whitish throat. The mandible is blackish, not pale; the feet are darker; the nostril is more rounded and less operculate.

This species is not very common, judging by the number of specimens at hand. Peruvian records are from La Gloria and Garita del Sol. There is a single Ecuadorian record, from Machay; the bird recorded from Baeza proves to be a specimen of *Tyranniscus cinereiceps*.

SPECIMENS EXAMINED

O. plumbeiceps.—

COLOMBIA:

- "Bogotá," 4 (?) (incl. a paratype);
La Candela, 1 ♂;
Gallera, 1 ♂;
Miraflores, 1 ♀;
San Antonio, 1 ♀;
Las Lomitas, 1 ♀;
Salento, 1 ♀;
Las Cruces, 1 ♀.

ECUADOR:

- Oyacachi, 2 ♂.

PERU:

- Idma, 2 ♂, 1 ♀;
Huachipa, 2 ♀.

Tyrannulus elatus (Latham)

Sylvia elata LATHAM, 1790, Ind. Orn., II, p. 708—based on Daubenton, Pl. Enl., 703, fig. 2; Cayenne.

Tyrannulus reguloides RIDGWAY, 1888 (Aug.), Proc. U. S. Nat. Mus., X, p. 521—Diamantina, near Santarem, Brazil; U. S. Nat. Mus.

Tyrannulus reguloides panamensis THAYER AND BANGS, 1906, Bull. Mus. Comp. Zool., XLVI, p. 218—Savanna of Panamá; ♂; Mus. Comp. Zool.

Tyrannulus elatus benii CARRIKER, 1935 (Oct. 10), Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 336—Chatarona, near Reyes, Bolivia; ♂; Acad. Nat. Sci. Phila.

A series of two hundred and thirty-five specimens of this species demonstrates such great variation among individuals from the same localities that I find it quite impossible to recognize any subspecies. In the matter of size, the largest bird I have measured is from northeastern Peru and the smallest from southeastern Ecuador.

¹ Specimens in Field Museum of Natural History, Chicago.

The birds from the Rio Negro, Brazil, show the darkest extreme of coloration but they are not consistent and many specimens from that region can be matched by birds from localities far distant. Similarly, the brightly colored birds from Panamá can be matched by specimens from other places, including the Guianas.

Aside from the variation in general tone of coloration, there are certain restricted areas that vary in color in a manner I am unable to explain except on the basis of simple individual variation. Thus, the sides of the head below the eyes may be gray or even whitish or may be definitely greenish yellow or an intermediate hue. The lores may be white or inconspicuously grayish. The sides of the crown are sometimes light gray, sometimes greenish, and sometimes overlaid with dusky. The throat may be whitish, grayish, or yellowish. The black of the cap may be broad and heavy or may be found only on the tips of the median feathers. The yellow of the crest varies considerably in depth of hue. Most of the yellow-throated birds are females but not all of them nor are most of the females so marked. Immature specimens, as well as adults, show the various types of coloration which, thus, may not be ascribed to differences of age.

Two birds from the Rio Negro, Brazil, have extensive remainders of juvenal plumage indicating this plumage to be largely Bone Brown, with buffy or cinnamonaceous tips on the feathers.

Peruvian records of *T. elatus* are from Sarayacu, "Upper Ucayali" (= near Cashiboya), Chayavitas, Yurimaguas, Moyobamba, and Pebas.

SPECIMENS EXAMINED

T. elatus.—

FRENCH GUIANA:

- Cayenne, 4 ♂, 3 ♀.

DUTCH GUIANA:

- Paramaribo, 8 ♂, 3 ♀, 2 (?);
Little Wanica, 1 ♀.

BRITISH GUIANA:

- Carimagua, 1 ♂.

VENEZUELA:

- Altigracia, Suapure, Maipures, Cristóbal Colón, Mt. Duida, and El Merey, 5 ♂, 3 ♀, 1 ♀.

BRAZIL:

- Faro, Rio Negro (Mansos, Muirapimá,

Igarapé Cacao Pereira, Yucabí, Tauapessasu, Santa Isabel, Camanaos, San Gabriel, Carvoeira, Tatú, Cucuhí, and Tabocal), Utinga, Rio Tocantins (Baíão, Mocajuba, Alcobacá, Arumatheua), Rio Xingú (Tapará, Porto de Moz), Rio Tapajoz (Aramanay, Igarapé Brabo, Tauary), Villa Bella Imperatriz, Rio Madeira (Borba, Rosarinho, Santo Antonio de Guajará), and Tefé, 95 ♂, 48 ♀.

PANAMÁ:

Chiriquí, Gamboa, El Villano, El Real, and Savanna near Panamá, 4 ♂, 1 ♀.

COLOMBIA:

"Bogotá," La Morelia, Puerto Valdivia, within twenty miles of Honda, Quibdo, Buenaventura, Cali, Media Luna, Rio Frío, Barbacoas, and Bonda, 7 ♂, 8 ♀, 11 (?).

ECUADOR:

Esmeraldas, Pambilar, San Javier, and mouth of Rio Curaray, 5 ♂, 3 ♀.

PERÚ:

Candamo, 1 ♂;
Rio Seco, 1 ♀;
Rio Mázan, 2 ♀;
Iquitos, 1 ♂;
Puerto Indiana, 4 ♂, 5 ♀;
Orosa, 2 ♂;
Santa Rosa, 3 ♂.

Acrochordopus zeledoni leucogonys
(Sclater and Salvin)

Tyranniscus leucogonys SCLATER AND SALVIN, 1871, P. Z. S. London for 1870, p. 841, Pl. LIII, fig. 1—Bogotá; cotypes in British Mus.

There is a single record of *leucogonys* from Marcapata, southeastern Perú, which justifies the inclusion of it in the Peruvian list. I have no material from Perú and very little from other countries. A female from Zamora, Ecuador, three "Bogotá" skins, and a bird without given sex from Buena Vista, Colombia, are at hand to represent the present form and one of the cotypes of *zeledoni* from Barranca, Costa Rica, a male from Aquinares, the same country, and a male from Boquete, Panamá, to represent the typical form.

There is not very much difference between the two series but typical *zeledoni* appears to have a whiter, less yellowish, throat and grayer, less greenish, pectoral stripes. Whether these characters would be found to hold in a more adequate series is problematical but, for the present, I prefer to recognize *leucogonys*.

Ornithion inerme Hartlaub

Ornithion inerme HARTLAUB, 1853, Jour. für Orn., I, p. 35—South America (= Bahia; Hellmayr).

Microtriccus fasciatus CARRIKER, 1934 (June 25), Proc. Acad. Nat. Sci. Phila., p. 328—Shapaja, Rio Huallaga, Perú; ♀; Acad. Nat. Sci. Phila.

The present species has a rather extensive range but is not clearly divisible. A specimen from Utinga, near Pará, differs from all the others at hand by its decidedly grayish tone, with the yellowish tints lacking or greatly reduced, but another specimen, from Santa Maria de São Miguel, nearby, is yellowish like the birds from other localities. A male from Aramanay, Rio Tapajoz, has the throat more extensively whitish than the rest of the series, most of which have, however, a trace of whitish in that region. Specimens from Perú and Ecuador are of maximum size but there is no distinction that may be maintained on this basis.

"*Microtriccus fasciatus*" appears to have been based on a young bird of the present species which had ochraceous wing-bars, a character of which traces are observable in one specimen from Roraima. Other points in the original description agree exactly with *O. inerme*.

I am doubtful of the validity of the genus *Microtriccus* which differs from *Ornithion* only by its shorter tail and certain details of coloration such as the brown cap and unbarred wing (in the adult). I propose, therefore, to merge it with *Ornithion* and to call its single species *Ornithion semiflavum*.

I am a little sceptical regarding the occurrence of *O. inerme* in Bahia, accepted by Hellmayr as type locality. The type was without given locality and the specimen recorded by Pelzeln as from Bahia was not collected by himself but was a skin in the Vienna Museum purchased from one H. Frank. Pinto does not include the species in his book on the birds of Bahia and Mrs. Naumburg's collector, Kaempfer, failed to obtain it. The locality should, therefore, be taken with caution although it is not certainly incorrect.

SPECIMENS EXAMINED

O. inerme.—

BRAZIL:

- Utinga, 1 ♂;
 Santa Maria de S. Miguel, 1 ♂;
 Rio Tapajoz, Tauary, 1 ♀;
 Aramanay, 1 ♂;
 Piquiatuba, 1 ♀;
 Rio Negro, Tatú, 1 ♂.

VENEZUELA:

- Río Mato, 1 ♂;
 Suapure, 1 ♂;
 Mt. Duida, Caño Seco, 1 ♂;
 Esmeralda, 2 ♀;
 Mt. Roraima, Arabupu, 1 ♂.

ECUADOR:

- Río Suno, above Avila, 1 ♂;
 below San José, 1 ♂.

PERÚ:

- Lagarto, 1 ♂;
 Santa Rosa, 1 ♀;
 Río Negro, west of Moyobamba, 1 ♂.

[? BOLIVIA]:

- no locality (Rusby Coll.), 1 (?).

Leptopogon superciliaris albidiventer
 Hellmayr

Leptopogon superciliaris albidiventer HELL-
 MAYR, 1918, Verh. Orn. Ges. Bayern, XIII,
 p. 305—Quebrada Onda, Yungas of Cocha-
 bamba, Bolivia; ♂; Munich Mus.

Bolivian birds are quite uniform with respect to the distinctly whitish wing-bars, but in southeastern Perú there is an occasional tendency toward the buffy wing-bars of true *superciliaris*. One specimen from Caradoc shows this tendency best but the bird appears to be not fully adult. An Idma specimen is very little different in this respect from the Bolivian birds but it and two other Idma skins are very slightly brighter yellow on the belly, though not so bright as *superciliaris*. In the southern part of the range of *s. superciliaris*, some specimens show the wing-bars as whitish as does *albidiventer* although the belly always is stronger yellow and the back brighter green.

Peruvian records are from Huaynapata, La Oroya, and La Pampa.

* ***Leptopogon superciliaris superciliaris***
 Tschudi

L(eptopogon) superciliaris TSCHUDI, 1844 (May), Arch. Naturg., X, (1), p. 275—Perú; Montaña de Vitor suggested by Hellmayr, 1927; Berlin Mus.

Leptopogon auritus TACZANOWSKI, 1874, P. Z. S. London, p. 134—Amable Maria, Perú; type formerly in Warsaw Mus., now lost.

Leptopogon superciliaris intermedius CAR-
 RIKER, 1934 (June 25), Proc. Acad. Nat. Sci.
 Phila.; LXXXVI, p. 328—Eneñas, Dept.
 Junín, Perú; ♂; Acad. Nat. Sci. Phila.

A good series of birds from various localities extending from central Perú to northeastern Ecuador shows a rather definite tendency toward deeper cin-
 namomeous or rufescent coloration of the wing-bars in the birds from the northern parts of this range, but it is not constant enough to warrant the erection of a sub-
 species for the northern birds. In the southern part of the range there is an obvious tendency toward the adjacent *albidiventer* and four specimens from this region have the wing-bars whitish or faintly buffy and the belly lighter yellow than usual. Other specimens show a vary-
 ing amount of rufescence on the wing-bars and depth of color on the belly, reaching a maximum intensity that is exceeded by no more than three or four of the northern specimens. None of the northern birds is as pale as the palest central-Peruvian examples. It is unfor-
 tunate, in one respect, that this form was not described from the portion of its range where the deeper color is more regular, but all three names listed above were applied to specimens from the same region—*superciliaris* and *intermedius* to birds with light wing-bars; *auritus* to a rufous-winged specimen.

I believe, however, that *poliocephalus* (Cabanis and Heine, 1859, Mus. Hein., II, p. 55—New Granada = Bogotá) deserves recognition. In coloration it stands inter-
 mediate between *superciliaris* and *albi-
 diventer* but in a different way from the central-Peruvian specimens discussed above. The upper parts are sometimes as dull as in *albidiventer*; the belly is inter-
 mediate; the wing-bars are variably inter-
 mediate. It resembles *transandinus* more than any other form and is sometimes almost indistinguishable from it but usually has the throat more whitish, the breast less heavily clouded and more yellowish, and the back of the head apparently always without the tinge of green that is shown by many *transandinus*, sometimes very pronouncedly.

Specimens from central and eastern Colombia make up the series of *poliocephalus* but one bird from Cocal and one from Alto Bonito, western Colombia, agree better with the west-Ecuadorian specimens. Specimens from eastern Panamá can not be distinguished from this western series, making it necessary to place *troglodytes* (Griscom, 1929, Bull. Mus. Comp. Zool., LXIX, p. 174—Cana, eastern Panamá) as a synonym of *transandinus*, the range of which thus extends up the western coast of Ecuador and Colombia to the southern part of Panamá. *L. s. hellmayri* (Griscom, *l. c.*, p. 175—Carrillo, Costa Rica) is a little brighter in coloration and has more olivaceous edging on the back of the head (though one specimen of *transandinus* from Lita, Ecuador, is well supplied with this coloration) and may be maintained as reasonably distinct.

A specimen from "Yuntas" (? = Juntas de Tamañá) can be assigned here though its head is somewhat discolored and brownish.

In the other direction, *L. s. venezuelensis* (Hartert and Goodson, 1917, Novit. Zool., XXIV, p. 413—Cumbre de Valencia, Venezuela) is brighter green above and brighter yellow below than *poliocephalus*, with a stronger yellow wash on the breast. It is fully as distinguishable as any of the other forms, none of which has any character that is not shared to some extent with one or more of the others.

Records of *superciliaris superciliaris* from Perú are from La Merced, Monterico, Eneñas, Amable Maria, Ropaybamba, Paltaypampa, Ray-Urmana, Pumamarca, Perico, and Moyobamba.

SPECIMENS EXAMINED

L. s. albidiventer.—

BOLIVIA:

- Locotal, 10 ♂, 1 ♀;
- Roquefald, 1 ♂;
- Yungas, 1 (?).

PERÚ:

- Río Inambari, 1 ♂, 1 ♀, 1 (?);
- Santo Domingo, 2 ♀;
- Caradoc, 1 ♀;
- Idma, 2 ♂, 1 ♀.

L. s. superciliaris.—

PERÚ:

- Tulumayo, 3 ♂, 5 ♀, 1 (?);

- Utcuyacu, 2 ♀;
- Pozuzo, 1 ♂;
- Vista Alegre, 2 ♂¹;
- Huachipa, 4 ♂¹, 3 ♀¹;
- Rioja, 1 ♀¹;
- Huambo, 1 ♂;
- San Ignacio, 2 ♂, 1 ♀;
- Lomo Santo, 1 (?);
- Río Negro, 1 ♂;
- Huarandosa, 3 ♂, 1 (?).

ECUADOR:

- Zamora, 2 ♂, 1 ♀;
- Río Suno, above Avila, 2 ♂;
- mouth of Río Curaray, 1 ♂.

L. s. transandinus.—

ECUADOR:

- Paramba, 3 ♂;
- Lita, 1 ♀;
- "Quito," 1 (?);
- Río de Oro, 1 ♂, 1 ♀, 1 (?);
- Naranjo, 1 ♀;
- Las Piñas, 1 ♀;
- La Chonta, 1 ♀.

COLOMBIA:

- Cocal, 1 ♀;
- Alto Bonito, 1 ♂;
- "Yuntas" [? = Juntas de Tamañá], 1 ♂

PANAMÁ:

- Tacarcuna, 5 ♂, 2 ♀.

L. s. hellmayri.—

PANAMÁ:

- Calovevora, 1 ♂;
- Veragua, 1 (?);
- Santa Fé, 1 ♂, 1 ♀.

L. s. poliocephalus.—

COLOMBIA:

- "Bogotá," 5 (?);
- Villavicencio, 2 ♂;
- Buena Vista, 1 ♂, 1 ♀;
- east of Palmira, 1 ♂, 1 ♀;
- Peque, 1 ♂.

L. s. venezuelensis.—

VENEZUELA:

- Cumbre de Valencia, 1 ♂ (type), 1 ♀;
- Quebrada Seca, 1 ♂, 3 ♀;
- Caripe, 1 (?);
- Cotiza, 1 ♂, 2 ♀, 2 (?);
- Guácharo, 1 ♂, 1 ♀;
- Cristóbal Colón, 3 ♂, 2 ♀;
- Río Neveri, 1 ♂, 1 ♀.

TRINIDAD:

- Carenage, 1 ♂;
- Heights of Aripo, 1 ♂.

Leptopogon amaurocephalus peruvianus
Sclater and Salvin

Leptopogon peruvianus SCLATER AND SALVIN,
1867, P. Z. S. London, p. 757—Chyavetas,
Perú; British Mus.

Throughout the present species there is considerable variation in the hue of the cap, due in part to individual variation but

¹Specimens in Field Museum of Natural History, Chicago.

also to the comparative ages of the birds. I have no specimens in fully juvenal plumage but certain examples of various subspecies that are not fully adult have the top of the head distinctly greenish though with a brownish tone. Between these and the adults there are birds with varying degrees of intermediate color though nothing I can find of taxonomic significance. Variation in the color of the wing-bars also occurs according to the freshness of the plumage, and molting specimens sometimes show both whitish and buffy feathers in the region in question. Nevertheless, there are differences and extremes of average coloration that permit the recognition of a number of subspecies, all of which vary in the manner mentioned above.

The Peruvian birds represent the darkest extreme of average coloration, with the top of the head the darkest brown, the back the darkest green, and the breast the most strongly overlaid with greenish color in rather marked distinction from the belly. Birds of this character occur also in northern Bolivia, extreme eastern Colombia, and the region of Mt. Duida, Venezuela, and presumably the records from Mt. Roraima and British Guiana refer to birds of this character. The largest specimen at hand is from Mt. Duida (sex unmarked; wing, 68 mm.; tail, 63) but the next in size is from Bolivia (♂; wing, 66.2; tail, 56.5).

The wing-bars average broader and deeper in coloration than those of typical *amaurocephalus* although some examples of the typical form are not clearly distinguished by this character. East-Bolivian specimens appear to be referable to *amaurocephalus* as are Paraguayan specimens and I am unable to subdivide this subspecies with the material at hand.

While one skin from the eastern side of the Eastern Andes of Colombia and one "Bogotá" skin agree well with *peruvianus*, other "Bogotá" skins and a bird from Chicoral show more resemblance to the Santa Marta *diversus* to which I refer them. This subspecies is extremely like some examples of *amaurocephalus*, with the breast pale and more yellowish than green-

ish and with the upper parts light and somewhat dull green. The top of the head is nearly the same hue of brown as in *amaurocephalus* but the tips of the feathers usually show a dusky shading that I have seen equally pronounced only in one east-Brazilian specimen, a male from Fazenda Cayoá, São Paulo.

The Central American forms, *pileatus* and *faustus*, do not appear to be very distinct from each other though they are rather darker than *diversus*. However, I have only three topotypes of *pileatus*, from Guatemala, two of which are quite old. Bangs, when describing *faustus*, pointed out that Guatemalan skins were intermediate between Costa Rican and Mexican birds but more like the Mexican examples. More study of the Central American representatives is needed.

Peruvian records of *peruvianus* are from La Merced, Monterico, Samiria, Chayavitas, and Nauta.

SPECIMENS EXAMINED

L. a. amaurocephalus.—

BRAZIL:

- São Paulo, Victoria, 2 ♂;
- São Sebastião, 1 ♂, 1 ♀;
- Fazenda Cayoá, 1 ♂;
- Alto da Serra, 1 ♂;
- Ubatuba, 1 ♂;
- Piquete, 1 ♂;
- Avanhandava, 1 ♂;
- Rio de Janeiro, 1 (♂);
- Matto Grosso, Chapada, 4 ♂, 3 ♀, 3 (?);
- Barão Melgaço, 1 ♂.

PARAGUAY:

- Sapucay, 1 ♂, 1 ♀.

BOLIVIA:

- Prov. Sara, "Camp Woods," 1 ♂, 2 ♀;
- Vermejo, 1 ♀.

L. a. peruvianus.—

BOLIVIA:

- Todos Santos, 1 ♀;
- Mouth of Río San Antonio, 1 ♂, 1 ♀.

PERÚ:

- Santa Rosa, 1 ♀;
- Mouth of Río Urubamba, 2 ♀.

COLOMBIA:

- Villavicencio, 1 ♂;
- "Bogotá," 1 (?).

VENEZUELA:

- Mt. Duida, Caño Sero, 1 ♂, 1 ♀, 1 (?).

L. a. diversus.—

COLOMBIA:

- Chicoral, 1 ♂, 1 (?);
- "Bogotá," 5 (?);
- Santa Marta, Bonda, 2 (?).

L. a. faustus.—

PANAMÁ:

- Veraguas, Santa Fé, 1 ♂, 1 ♀;
 El Villano, 1 ♂;
 Chiriquí, Bogavá, 2 ♀;
 Savanna near Panamá, 1 ♀;
 [Lion Hill], 1 ♂;
 Cerro Montoso, 1 ♀.

COSTA RICA:

- Guapiles, 2 ♂, 1 ♀;
 Miravalles, 1 ♀.

NICARAGUA:

- Los Sabalos, 1 ♂, 1 ♀, 1 (?).

L. a. pileatus.—

GUATEMALA:

- Chimoxan, 1 ♂;
 (no other locality), 2 (?).

Leptopogon taczanowskii Hellmayr

Leptopogon rufipectus TACZANOWSKI, 1884, Orn. Pér., II, p. 249—Ropaybamba and Ray-Urmana, Perú; ♀ from Ray-Urmana claimed as type by Stolzmann and Domaniewski, 1927; Warsaw Mus.

Leptopogon taczanowskii HELLMAYR, 1917, Verh. Orn. Ges. Bay., XIII (2), p. 198—new name for *Leptopogon rufipectus* Taczanowski (not *Tyrannula rufipectus* Lafresnaye, 1846).

Leptopogon inca BANGS AND PENARD, 1922 (Oct. 17), Proc. Biol. Soc. Wash., XXXV, p. 225—new name for *L. rufipectus* Tacz.

I can find no distinctions between birds from central Perú and a single specimen from the northern part of the country.

It is possible that this form should be considered as a subspecies of the Ecuadorian-Colombian *rufipectus* which it matches in pattern and in some details of coloration. There is, however, a rather pronounced hiatus between the ranges of the two forms with no suggestion of intermediacy in coloration in the specimens I have examined and it may be best to keep them specifically distinct for the present.

I revert to the specific name, *rufipectus*, for the northern birds since the name is not clearly preoccupied by Lesson's earlier *rufopectus* even if the names of the respective genera in which they were originally placed, *Tyrannula* and *Tyrannulus*, are considered to be homonymous, a point also open to question. The series at hand shows no difference in size between Colombian and Ecuadorian birds.

Records of *taczanowskii* are from Ray-Urmana, Ropaybamba, and Maraynioc.

SPECIMENS EXAMINED

L. rufipectus.—

COLOMBIA:

- Aguadita, 2 ♂, 2 (?);
 Santa Elena, 1 ♀;
 Salento, 1 ♂;
 La Candela, 2 ♀;
 La Palma, 1 ♀;
 "Bogotá," 4 (?).

ECUADOR:

- Baeza, 2 ♂, 1 ♀;
 upper Sumaco, 3 ♂, 1 ♀.

L. taczanowskii.—

PERÚ:

- La Lejía, 1 ♂;
 Chelpe, 2 ♂, 1 ♀;
 Rumicruz, 1 ♂;
 San Miguel, foot of Machu Picchu, 1 ♂, 2 ♀;
 Idma, 1 ♂.

Mionectes striaticollis striaticollis
(D'Orbigny and Lafresnaye)

M(uscicapa) striaticollis D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, Cl. 2, "Syn. Av.," p. 51—Yuracares, rep. Boliviana; Paris Mus.

Birds from southeastern Perú, as far northwestward as the Urubamba Valley, are in relatively close agreement with typical Bolivian specimens. The Urubamba birds show a tendency toward *poliocephalus* of central Perú by occasional brightening of general color and widening of the clear yellow area on the belly but the broad striping on the throat and chest remains distinctive and some examples are indistinguishable from the Bolivian series.

The bill, in this form, has the mandible more uniformly pale than it is in any of the other subspecies. Occasionally there is a little darkening toward the tip but it is rarely pronounced. In *poliocephalus* the distal portion of the mandible is more noticeably brown; in the remaining forms it is rather abruptly dusky. The Urubamba Valley specimens agree with Bolivian skins in respect to the more uniform mandible.

Records assignable to this form are from Huaynapata and Río Cadena.

Mionectes striaticollis poliocephalus
Tschudi

M(ionectes) poliocephalus TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 275—Perú; Valley of Vitoc suggested by Hellmayr, 1927; Mus. Neuchâtel.

This form has the brightest and yellowest-green back, on average, of all the forms of the species though there is much variation in this respect. Birds at hand from Chelpe are the brightest of all; those from Tulumayo, Rumicruz, and Utcuyacu average distinctly darker, but this is certainly only individual variation. The top of the head usually is clear gray but there is sometimes a suggestion of green on the nape, never as pronounced as in most *palamblae*. The belly is about the same as in *palamblae* or a little paler yellow but the breast, throat and flanks are more boldly marked than in that form, being about midway between *palamblae* and *striaticollis* in this respect. The tip of the mandible is darker brown than in *striaticollis*, lighter than in *palamblae*.

Records that may be assigned to this form are from Garita del Sol, Puyas-Yacu, Paltaypampa, and Tamiapampa, all in the Subtropical Zone above the Chanchamayo Valley.

***Mionectes striaticollis palamblae*
Chapman**

Mionectes striaticollis palamblae CHAPMAN, 1927 (Feb. 19), Amer. Mus. Novit., No. 250, p. 4—Palambla, Perú; ♂; Amer. Mus. Nat. Hist.

Mionectes striaticollis flaviventris CARRIKER, 1934 (June 25), Proc. Acad. Nat. Sci. Phila., LXXXVI, p. 329—Río Jelashte, Perú, ♂; Acad. Nat. Sci. Phila.

This form has the clearest under parts of all the forms, with a minimum of dark streaking on the flanks and of light streaking on the throat and breast while the back of the head shows a transition from the green of the back to the gray of the anterior crown. There is some variation in the depth of yellow on the belly but it is always as deep as in the maximum of the other forms and deeper than in most. The breast is strongly dark green, approaching *columbianus* in that respect.

I have not recently examined the birds from Vista Alegre and Chinchao that I once (1930, Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 397) referred to *poliocephalus*, but my notes indicate that these skins were rather finely streaked on the chest and had a certain amount of

greenish coloration on the hind neck. I believe they must go in *palamblae*.

Through the kindness of Mr. R. M. de Schauensee and Mr. James Bond of the Academy of Natural Sciences of Philadelphia I have been enabled to see the typical series of *M. s. "flaviventris."* There is no doubt that the upper parts of the Río Jelashte birds are very slightly brighter and more yellowish green than those of specimens from a little farther north but they are not as bright as in some *poliocephalus* toward which they tend also in other respects. The striations of the throat and breast are broader than in typical *palamblae* but finer than in *poliocephalus* and the greenish coloration on the occiput is likewise in an intermediate condition. Judging by the situation in other forms of the species, the differences exhibited by the series of "*flaviventris*" in comparison with more typical *palamblae* are about what might be expected within the limits of individual variation of *palamblae*, allowing for some geographical and taxonomic approach toward *poliocephalus*. The tip of the mandible in the Río Jelashte and Utcubamba birds as well as in the Vista Alegre and Chinchao examples, is contrastingly dusky as in other *palamblae*.

Records assignable to *palamblae* are from Tambillo, Tabaconas, Chirimoto, Huambo, Chinchao, Vista Alegre, Tamborapa, San Ignacio, Chira, and Leimebamba.

The ranges of *columbianus* and *viridiceps* come very near to overlapping in southern Ecuador. Eleven birds from Zaruma, Alamor, Las Piñas, El Chiral, and Punta Santa Ana are definitely *viridiceps* but three examples from San Bartolo, Salvias, and Celica are just as certainly *columbianus*. However, these last-named localities are at an elevation of from 6900 to 7500 feet while the specimens of *viridiceps* are all from 6000 feet or below. From the material at hand, therefore, it appears that there is an altitudinal difference in the ranges of these two forms although both presumably are inhabitants of the Subtropical Zone. Future study in the field should be made to determine the exact nature of the boundary that limits the ranges of these two forms in this region.

SPECIMENS EXAMINED

M. s. straticollis.—

BOLIVIA:

- Cochabamba, Locotal, 3 ♂, 1 ♀;
Yungas, 3 ♂, 1 ♀;
Incachaca, 3 ♂;
Roquefalta, 1 ♀;
Chaco, 1 ♂;
La Paz, Nequejahuir, 1 ♀.

PERU:

- Oconeque, 1 ♂;
Río Inambari, 2 ♀;
Idma, 4 ♂, 2 ♀;
San Miguel Bridge, 2 ♂, 1 ♀.

M. s. poliocephalus.—

PERU:

- Chelpes, 8 ♂;
Tulumayo, 1 ♀;
Rumicruz, 1 ♀, 1 (?);
Uteyacu, 3 ♂, 2 ♀.

M. s. palambae.—

PERU:

- Palambala, 2 ♂ (incl. type);
Lomo Santo, 3 ♂, 1 ♀;
Uchco, 1 ♂;
Chugur, 1 ♀;
Taulis, 1 ♀;
Río Jelashte, 4 ♂ (incl. type of "*flaviventris*")¹, 1 ♀¹;
Uteubamba, 1 (?).¹

M. s. viridiceps.—

ECUADOR:

- Zaruma, 3 ♂ (incl. type), 3 ♀;
Alamor, 1 ♀;
Las Piñas, 1 ♀;
El Chiral, 2 ♀;
Punta Santa Ana, 1 ♀;
Gualera, 1 ♂;
Coco, 1 ♀;
Chimbo, 1 ♀;
"Papallacta," 2 ♂, 1 ♀ (locality doubtful);
"Pichincha," 1 ♂, 1 ♀ (locality doubtful).

M. s. columbianus.—

ECUADOR:

- Celica, 1 ♂;
Salvias, 1 ♀;
San Bartolo, 1 ♂;
(above) Sabanilla, 1 ♀;
above Baesa, 1 ♂;
Oyacachi, 1 ♀;
Sumaco, 4 ♂, 1 ♀.

COLOMBIA:

- Cerro Munchique, 1 ♀;
El Roble, 1 ♂;
east of Palmira, 1 ♀;
Santa Elena, 1 ♂;
La Candela, 1 ♂².

Mionectes olivaceus fasciaticollis
Chapman

Mionectes olivaceus fasciaticollis CHAPMAN,
1923 (April 11), Amer. Mus. Novit., No. 67, p.

¹ Specimens in Academy of Natural Sciences of Philadelphia.

² Specimen in Field Museum of Natural History, Chicago.

9—Tulumayo, Vitoc Valley, Perú; ♂; Amer. Mus. Nat. Hist.

I can find no clear distinctions from the southeastern portion of Perú to northeastern Ecuador although the most northern birds show a little tendency toward darker markings on the breast and lighter, duller yellow on the belly in a more restricted area, probably a variation in the direction of *pallidus* of eastern Colombia.

A young male from Río Távora, southeastern Perú, has all its colors duller than usual and the light striping and edges of the throat and breast so reduced and inconspicuous as to give a superficial resemblance to *olivaceus*, though the colors are much too dull. The peculiar appearance undoubtedly is due to immaturity since young examples of some of the other subspecies are duller and less prominently marked than the adults of the same forms. A young male from the Río Suno, Ecuador, is nearly as dull as the Río Távora specimen.

An adult male from "Guayabamba" (= upper Río Huambo) has the center of the abdomen quite whitish and the throat a little grayish but has the breast and flanks marked with green and yellow, both of a duller tone than usual. This probably is no more than individual variation since a "Guayabamba" male in first annual plumage is normally yellowish.

The type of *fasciaticollis* is said by the describer to be a female but it was originally sexed by the collector as a male and, although it lacks the modification of the ninth (subexternal) primary found in adult males, it is of large size (wing, 69 mm., tail, 50.5) and is rather certainly a male in first winter plumage.

Peruvian records are from Huaynapata, Yahuar Mayo, Monterico, La Gloria, and Huambo.

Among the series of related forms studied in the present instance are thirteen examples from the Mérida region of Venezuela which combine the dorsal appearance of *venezuelensis* with the ventral coloration and pattern of *galbinus*. Since they occupy an area somewhat apart from the known ranges of these two forms, they may well deserve distinction by name and may be known as follows.

Mionectes olivaceus meridae, new subspecies

TYPE from El Valle, near Mérida, Venezuela. No. 500,183, American Museum of Natural History. Adult male collected February 18, 1897, by Salomon Briceño Gabaldon and sons.

DIAGNOSIS.—Intermediate between *M. o. venezuelensis* of northeastern Venezuela and *M. o. galbinus* of the Santa Marta region of northern Colombia, having the upper parts about the same as those of *venezuelensis* but the under parts as in *galbinus*; the individual characters are not intermediate.

RANGE.—Apparently restricted to the Mérida region of Venezuela, probably ranging southward to the Colombian border.

DESCRIPTION OF TYPE.—Top of head dark Olive Green with indistinct darker centers on the feathers; back light Olive Green with pale shafts, a dusky median lunule, gray bases and, more pronouncedly on the mantle, a whitish area basad of the dark lunule, but all these markings are inconspicuous unless the feathers are disarranged. Lores dull, light olivaceous, freckled with paler dots; auriculars yellowish olive with paler shafts; a whitish patch behind the upper posterior corner of the orbit; chin and throat Citron Yellow, freckled with Serpentine Green; breast with (concealed) whitish shaft-stripes, submarginal stripes of Serpentine Green, and margins of Barium Yellow, these markings continued somewhat less conspicuously down the flanks; belly Citron Yellow X Straw Yellow; under tail-coverts Straw Yellow. Wings dark brown; remiges margined, very narrowly on the primaries, with Dull Citrine X Buffy Citrine, becoming whitish toward the tips of the tertials; ninth (subexternal) primary longer than the tenth, with an abrupt decrease in width about 20 mm. from the tip of the inner web which is then of uniform, narrowed width distad to about 7 mm. from the tip where it rapidly widens and then narrows to an acute tip (producing a long indentation on the inner margin of the feather); the shaft is bent slightly outward for the terminal 8 mm.; lesser upper wing-coverts like the back; median and greater series dark brown with the outer margins olivaceous basally (beyond the tips of the overlying series) but Cartridge Buff terminally, forming two interrupted wing-bars; under wing-coverts Cream Buff; inner margins of remiges Light Buff. Tail warm Hair Brown with outer margins of the feathers olivaceous; under aspect of rectrices of a lighter and warmer tone. Bill (in dried skin) blackish with basal half of mandible pale brownish; feet pale brown. Wing, 70 mm.; tail, 50; exposed culmen, 11; culmen from base, 15; tarsus, 16.5.

REMARKS.—Females probably like the males but distinctly smaller and without the emarginated ninth primary though there may be a suggestion of slight alteration in the contour on the distal portion.

However, only one bird in the present series is sexed as a female and it is obviously an adult male, both by size and modified primary, agreeing exactly with the type, one sexed male and three obviously adult males without given sex. Three birds sexed as males have the size of the adult males but no strongly modified primaries. They probably are in first winter plumage. Three specimens, without given sex, also have unmodified primaries but are much smaller than the others (wing, 63–64 mm. instead of 68–71.5; tail, 45.5–47 instead of 50.1–56.5). Judging by the other subspecies of this group, these are females.

I have no hesitation in giving a name to this form in view of the kind of intermediacy that is presented. The upper parts are just as dark as in any *venezuelensis* while the under parts are just as bright and the throat is as definitely speckled, not striped, as in *galbinus*. It thus is impossible to refer the Mérida population to either of the other subspecies mentioned. There is no indication of approach toward *M. o. pallidus* of eastern Colombia as might be expected from the geographical position of the ranges.

A good series of specimens from the Veraguas region of Panamá is inseparable from *hederaceus* of western Colombia but a single young bird from Boquete, Chiriquí, seems to be closer to the Costa Rican *olivaceus* although there is a slight possibility that adult examples from western Panamá might fail to substantiate this assignment.

SPECIMENS EXAMINED

M. o. olivaceus.—

COSTA RICA:

Aguinara, 2 ♂, 1 ♀;
La Hondura, 1 ♂;
Navarrito, 2 ♂;
Guayabo, 1 (?);
Azahar de Cartago, 2 ♂;
Turrialba, 1 ♂.

PANAMÁ:

Chiriquí, Boquete, 1 ♀.

M. o. hederaceus.—

PANAMÁ:

Veraguas, Chitrá, 5 ♂;
Santa Fé, 2 ♂, 4 ♀;
Río Calovevera, 1 ♂;
[Líon Hill], 1 ♀;

Tacarcuna, 1 ♂, 5 ♀;
East slope of Tacarcuna, 1 ♀;
El Real, 3 ♂, 1 ♀.

COLOMBIA:

Juntas de Tamaná, 1 ♂;
Puerto Valdivia, 1 ♀;
Cocal, 1 ♂;
Nóvita Trail, 1 ♂;
San José, Cauca, 1 ♂, 1 ♀;
Barbacoas, 2 ♂, 2 ♀.

ECUADOR:

Paramba, 3 ♂, 1 ♀;
Mindo, 2 ♀;
"Pichincha," 1 "♂" [= ♀].

M. o. pallidus.—

COLOMBIA:

Buenavista, 1 [♂], 1 ♀ (type);
"Bogotá," 1 (?).

M. o. galbinus.—

COLOMBIA:

Santa Marta, Valparaíso, 8 ♂, 2 ♀, 9 (?);
El Libano, 1 ♀, 2 (?).

M. o. venezuelensis.—

VENEZUELA:

Guácharo, 1 ♂, 1 ♀ (type), 1 (?);
Cotiza, 1 ♂;
La Tigra, 1 ♀;
Campos Alegre Valley, 1 ♀;
Los Palmales, 1 ♂, 3 ♀;
Loma Redonda, 2 ♂;
Cumbre Chiquitos, 1 ♀;
Cristóbal Colón, 1 ♀;
Cumaná, 1 [♂];
Quebrada Seca, 2 ♂;
Cumbre Valencia, 1 ♂;
La Trinidad, 1 ♂;
"Brazil = Orinoco-skin," 1 (?).

M. o. meridae.—

VENEZUELA:

Mérida, 2 [♂], 2 [♀];
El Valle, 2 ♂ (incl. type), 2 [♂];
El Pantar, 1 ♂;
Escorial, 1 ♂, 1 [♂];
Culata, 1 [♂];
Lagunillas, 1 [♀].

M. o. fasciaticollis.—

ECUADOR:

Zamora, 2 ♂, 2 ♀;
Río Suno, above Avila, 1 ♂, 2 ♀;
below San José, 1 ♂, 2 ♀;
lower Sumaco, 1 ♂;
Cerro Galeras, 2 ♂.

PERÚ:

Huarandosa, 1 ♂;
"Guayabamba," (= upper Río Huambo),
2 ♂;
Nuevo Loreto, 1 ♂, 1 (?);
Chinchao, 1 ♂¹;
Huachipa, 3 ♂¹, 2 ♀¹;
San Ramón, 1 ♂¹;
Tulumayo, 1 ♂ (type), 4 ♀;
Posuzo, 1 ♂;
La Pampa, 1 ♀;
Río Távares, 1 ♂.

Pipromorpha oleaginea oleaginea
(Lichtenstein)

Muscicapa oleaginea LICHTENSTEIN, 1823,
Verz. Doubl. Berl. Mus., p. 55—Bahia; Berlin
Mus.

I have seen only a single specimen from anywhere near the type locality of *oleaginea*, an adult female from Lagôa Juparaná, Espirito Santo. This specimen has certain distinctions from seventy-nine other examples of the species from a wide range of localities in other parts of Brazil, agreeing with the characterization of typical *oleaginea* given by Mr. Todd (1921, Proc. Biol. Soc. Wash., XXXIV, pp. 176, 182, 184) in distinction from *chloronota*. The east-Brazilian bird has the under parts much like those of *pallidiventris* though paler than many of the latter, and with the breast a little darker in hue but without any olivaceous tinge. If these characters are constant, *oleaginea* should be restricted to the birds of southeastern Brazil. Pará and lower Amazonian specimens are quite different as will be shown below, and upper Amazonian examples belong to the still different *chloronota* whose characters are as follows.

Pipromorpha oleaginea chloronota
(D'Orbigny and Lafresnaye)

M[uscicapa] chloronota D'ORBIGNY AND
LAFRESNAYE, 1837, Mag. Zool., VII, Cl. 2,
"Syn. Av." p. 51—Yuracares, Bolivia; cotypes
in Paris Mus.

Pipromorpha oleaginea chapmani CHUBB,
1919, Ann. Mag. Nat. Hist., (9) IV, p. 302—
Villavicencio to Medina, Llanos of River Meta,
Colombia; British Mus.

North-Bolivian specimens differ from the single east-Brazilian *oleaginea* at hand by distinctly darker under parts with a strong olivaceous suffusion on the breast and throat. The belly frequently reaches a depth of color approaching Mars Yellow × Raw Sienna in great contrast to the light ochraceous of *oleaginea*, and there is always this tawny tendency even in the lighter extremes of individual variants.

I am unable to separate from the Bolivian specimens those from the nearby upper Río Madeira region of Brazil, two skins from Teffé, and a considerable series from the right bank of the lower Río Negro,

¹Specimens in Field Museum of Natural History, Chicago.

both banks of the upper part of that stream, southern Venezuela up to the Caura Valley, and southeastern Colombia. This is particularly interesting in view of the slight, though apparently definite, distinction of birds from the two banks of the lower Marañón in Perú.

Sixty-one specimens from the Guianas, the left bank of the lower Rio Negro and the region of the Jamundá, north of the Amazon in Brazil, and the area from the left bank of the lower Rio Madeira to the Pará district, south of the Amazon, agree fairly well with *chloronota* in coloration but have a notably different modification of the outer primaries. In *chloronota*, as apparently also in typical *oleaginea*, the outer primaries are very little modified, being relatively broadly rounded at their tips, sometimes with a slight subterminal sinuation on three or more feathers and a little narrowing of the tip though this is never acute. Such modification as exists occurs in both sexes, perhaps most often in the oldest birds.

The Guiana-Manaos-Pará series, even in apparently young birds, always shows distinctly more acuminate tips on at least the outermost primary, usually on three or four primaries. Sometimes the acumination is gradual but frequently the end of the feather is quite slender for five or six millimeters basad where it broadens rather rapidly. Dr. Chapman (1931, Bull. Amer. Mus. Nat. Hist., LXIII, p. 98) called attention to the same sort of structure in *P. o. pallidiventris* as compared with *parca*, and it is equally serviceable in the present instance.

Since there is a name available for the birds of the Pará district, which I find in close agreement with the lower Madeira-Manaos-Guiana specimens, the name may be used for this subspecies, now to be known as *Pipromorpha oleaginea wallacei* Chubb [1919, Ann. Mag. Nat. Hist., (9), IV, p. 301—Pará; British Mus.].

As synonymy, must be included *Pipromorpha turi turi* Sztolcman [1926, Ann. Zool. Mus. Pol. Hist. Nat., V (4), p. 225—Cayenne; ♂; Warsaw Mus.], based rather certainly on a gray aberration comparable to the type of "*Mionectes semi-*

schistaceus" Cherrie (1892, Proc. U. S. Nat. Mus. XV, p. 27—Guayabal, Costa Rica; U. S. Nat. Mus.) = *P. o. assimilis* (Sclater).

Pipromorpha oleaginea hauxwelli Chubb

Pipromorpha oleaginea hauxwelli CHUBB, 1919, Ann. Mag. Nat. Hist., (9) IV, p. 302—Pebas, Perú; ♂; British Mus.

Thirty-five birds from eastern Ecuador and adjacent parts of Perú north of the lower Marañón stand out rather distinctly from the large series of *chloronota* by reason of their lighter under parts although the upper parts are, if at all different, a little darker than the average of the other form. Accordingly, I suggest the recognition of *hauxwelli* for the population of this rather restricted area. Two skins from the Río Mázan are rather lighter green on the back than the specimens from the Napo but agree with them in ventral coloration and may be referred to *hauxwelli*. One specimen, labelled "Iquitos," is much like the birds from the south bank of the Marañón and, in fact, may have come from opposite Iquitos instead of from the same side of the river as the town of that name, but it is intermediate enough in characters to be placed here.

Pipromorpha oleaginea maynana Sztolcman

Pipromorpha turi maynana SZTOLCMAN, 1926 (Dec. 31), Ann. Zool. Mus. Pol. Hist. Nat., V (4), p. 226—Yurimaguas, Perú; ♂; Warsaw Mus.

Birds from south of the lower Marañón as well as west of the middle portion of the river (above the Pongo de Manserriche) and from the Río Ucayali are even lighter below than *hauxwelli* though with the throat averaging more greenish and, in addition, are lighter and more yellowish green above, agreeing with *pacifica* in dorsal, though not in ventral, coloration. The differences are not pronounced but are apparent both in most single specimens and in series although intergradation is complete and two or three specimens of each series are equivocal. The extremes, however, are pronounced.

The tendency of this form is toward the

characters of the light-colored western and Central American forms and there is particular approach toward *parca*, much more than is shown by any Colombian specimen of *chloronota* that I have seen. The west-Ecuadorian *pacifica* is still paler on the under parts but very similar above. There may be some significance, therefore, in the pale coloration of *maynana* in respect to possible lines of dispersal across the Andes in northern Perú which will justify the recognition of this form on the minor characters exhibited here. The coloration of the north-Venezuelan *pallidiventris* is very close to that of *parca* but the different shape of the outer primaries in these two forms is not bridged satisfactorily except by way of *wallacei* and *chloronota*.

The type of Sztolcman's "*maynana*" appears, from its description, to be a gray aberration like the types of "*turi*" and "*semischistaceus*" mentioned earlier. An occasional specimen at hand of one subspecies or another, including the present one, shows slight but distinct grayish tendencies, though none I have seen completely lacks all trace of olive coloration as is said to be the case in the three gray birds that were separately made the types of the three supposed new forms.

Van Rossem (1938, Field Mus. Nat. Hist., Zool. Ser., XXIII, p. 397) has proposed the submergence of *Pipromorpha* under *Mionectes*. He bases his contention on the grounds that some members of the genus *Pipromorpha* have the subexternal (ninth) primary narrower than the eighth or tenth as is the case in *Mionectes*. While admitting that the two genera are very similar in many respects, I believe that there is still sufficient difference on which to base generic distinction, more than the simple relative width of the outer primaries. Two distinct patterns of coloration are presented, each involving more than one species. In *Mionectes* the greatest modification occurs in the subexternal primary; in *Pipromorpha* the outer primary is most strongly modified. I find little evidence of the suggested reduction in width of the ninth primary in *Pipromorpha* in comparison with the tenth although single specimens sometimes have a slight sinuation

on the inner margin that reduces the width of the feather a little at that point. In *Mionectes* there often is a pronounced sexual difference in size, markedly less obvious in *Pipromorpha*. Possibly these features ought to be held as of no more than subgeneric value but the two groups are easily distinguished and I prefer to maintain their generic separation.

SPECIMENS EXAMINED

P. o. oleaginea.—

BRAZIL:

Espírito Santo, Lagoa Juparaná, 1 ♀.

P. o. chloronota.—

BOLIVIA:

Mouth of Río San Antonio, 2 ♂;

Mission San Antonio, 1 ♀.

BRAZIL:

Rio Madeira, Humaythá, 1 ♀;

Calamá, 2 ♂, 1 (?);

Rio Machados, Jamarysinho, 1 ♂;

Rio Roosevelt, "6th of March Rapids," 1 ♀;

Teffé, 1 ♂, 1 ♀;

Rio Negro, Tatú, 3 ♂, 2 ♀, 2 (?);

Mt. Curucuryari, 1 ♀;

Tabocal, 6 ♂;

Yucabí, 1 ♂, 1 ♀, 1 (?);

Muirapinimá, 1 ♀;

Santa Isabel, 1 ♂, 1 ♀;

Igarapé Cacao Pereira, 1 ♀;

San Gabriel, 2 ♂, 3 ♀;

Camanaos, 3 ♂;

Rio Uaupés, Ianarete, 4 ♂, 1 ♀.

VENEZUELA:

Mt. Duida, Caño Seco, 4 ♂;

Savana Grande, 1 ♂;

Valle de los Monos, 1 ♂;

Campamento del Medio, 2 ♂;

Pie del Cerro, 1 ♂;

Playa del Río Base, 3 ♂, 1 ♀;

Esmeraldas, 4 ♂;

[western] foot of Duida, 1 ♂, 1 ♀;

Rio Cassiquiare, Solano, 1 ♂, 1 ♀;

Buena Vista, 7 ♂;

El Merey, 1 ♀;

mouth of Río Ocamo, 1 ♀;

opposite mouth of Ocamo, 1 ♀;

Rio Huayña, junction of the Cassiquiare, 1 ♀, 2 (?);

Rio Orinoco, Suapure, 5 ♂;

Nericagua, 1 ♂;

Rio Caura, Nicaré, 3 ♀;

La Unión, 1 ♂, 2 ♀;

La Prisión, 1 ♂.

COLOMBIA:

Villavicencio, 1 ♂, 1 ♀;

Florencia, 2 ♀;

"Bogotá," 6 (?).

P. o. hauruvellii.—

ECUADOR:

mouth of Río Curaray, 12 ♂, 4 ♀;

Rio Suno, above Avila, 2 ♂, 2 ♀;

lower Río Suno, 2 ♂, 2 ♀;
below San José, 3 ♂;
mouth of Lagarto Cocha, 1 ♀.

PERÚ:

Apayacu, 4 ♂, 1 ♀;
Puerto Indiana, 1 ♂, 1 ♀;
Iquitos, 1 ♂;
Río Mázan, 2 ♂.

P. o. maynana.—

PERÚ:

Chayavitas, 2 ♂, 1 ♀;
Chamicuros, 1 ♂;
Río Seco, 1 ♂, 1 ♀;
Río Negro, west of Moyobamba, 1 ♂;
Pomará, 1 ♂, 2 ♀, 2 (?);
Orosa, 1 ♂, 2 ♀;
Lagarto, 2 ♂;
Santa Rosa, 2 ♂.

P. o. pacifica.—

ECUADOR:

Chongon Hills, 1 ♂;
Alamor, 2 ♂, 1 ♀;
Cebollal, 4 ♂, 2 ♀;
Las Piñas, 1 ♂;
Santa Rosa, 2 ♂;
Chone, 1 ♀;
Río de Oro, 1 ♀;
Carondelet, 1 ♂;
Esmeraldas, 1 ♀.

P. o. wallacei.—

BRAZIL:

Pará, Prata, 2 ♂;
Utinga, 3 ♂;
Providencia, 1 ♀;
Mocajutuba, 1 ♂;
Rio Tocantins, Arumatheua, 1 ♂;
Mocajuba, 1 ♂;
Rio Xingú, Tapará, 1 ♀;
Porto de Moz, 1 ♂;
Rio Tapajoz, Aramanay, 1 ♀;
Igarapé Brabo, 3 ♂, 1 (?);
Igarapé Amorin, 1 (?);
Caxiricatuba, 2 ♂, 3 ♀;
Rio Amazonas, Villa Bella Imperatriz, 1 ♂;
Rio Madeira, Igarapé Auará, 1 ♀;
Rosarinho, 2 ♂, 1 ♀;
Lago Miguel, 1 ♂;
Rio Negro, Hacienda Rio Negro, 1 ♂, 1 ♀;
Campos Salles, Manaos, 4 ♂;
Rio Jamundá, Faro, 1 ♀;
Castanhal, 4 ♂, 1 ♀;
Serra do Espelho, 2 ♂;
Boca Rio Paratucú, 2 ♂;
San José, 2 ♂.

FRENCH GUIANA:

Roche Marie, 2 ♂.

BRITISH GUIANA:

Tumatumari, 1 ♂;
Potaro Landing, 2 ♂;
Wismar, 1 ♀;
Bartica Grove, 1 ♂;
Rockstone, 1 ♂.

DUTCH GUIANA:

Little Wanica, 1 ♂;
Wanica, 1 (?);
Paramaribo, 2 ♂, 1 (?);

Lelydorp, Para, 1 ♂;
"Interior," 2 ♂.

P. o. pallidiventris.—

VENEZUELA:

(Rincón San Antonio, San Antonio, Hills of La Tigra, Cuchivano, Quebrada Seca, El Pilar, Salsipuede, Santa Ana Valley, Campos Alegre Valley, Cristóbal Colón), 15 ♂ (incl. type from Rincón San Antonio), 13 ♀.

TRINIDAD:

(Carenage, Caparo, Princetown, Valencia, Heights of Aripo), 10 ♂, 3 ♀, 1 (?).

TOBAGO:

Castare, 1 ♂.

P. o. parca.—

COLOMBIA:

(Puerto Valdivia, Honda, Chicoral, Andalusia, Fusugasugá, "Bogotá," Buritaca, Cacagualito, Minca, Bonda), 8 ♂, 6 ♀, 26 (?).

PANAMÁ:

(Barro Colorado Island, El Real, Río Chiman, Chepigana, Savanna near Panamá, Gatún, Lion Hill), 8 ♂, 4 ♀, 1 (?).

P. o. lutescens.—

PANAMÁ:

(Santa Fé, Chitrá, Cerro Larga, El Villano, La Colorado, La Marea), 21 ♂ (incl. type from Santa Fé), 6 ♀.

P. o. lutescens × *dyscola*.—

PANAMÁ:

Cerro Flores, 1 ♂;
Wilcox Camp, 1 ♂.

P. o. dyscola.—

PANAMÁ:

(Boqueron, Boquete, El Banco, Almirante, Cocoplum, Cebaco Is., Parida Is.), 17 ♂, 6 ♀, 1 (?).

P. o. assimilis.—

COSTA RICA:

Bonilla, Guayabo, Agua Caliente, Guapiles, Aquinares, Atalanta), 10 ♂.

NICARAGUA:

(Río Coco, Río Tuma, Ocotal, Matagalpa, Río Grande, Los Sabalos), 8 ♂, 5 ♀, 1 (?).

GUATEMALA:

(Finca Carolina, Finca Cipres, Finca Sepacuite, Finca El Espinosa, Secanquim, Chipoc, Vera Paz, Barrillos), 24 ♂, 16 ♀, 13 (?).

MEXICO

Jalapa, 1 ♂, 1 ♀;
Quintana Roo, Palmal, 1 ♂;
(no locality), 1 (?).

Pipromorpha macconnelli peruana
Carriker

Pipromorpha (sic) *macconnelli peruana* CARRIKER, 1930 (Dec. 15), Proc. Acad. Nat. Sci. Phila., LXXXII, p. 372—Perené, Chanchamayo, Perú; ♀ "adult" [= juv.]; Acad. Nat. Sci. Phila.

P. o. oleagina, CARRIKER, 1934 (June 25), op

cit., LXXXVI, p. 329, in text; "slightly immature."

The type of this interesting form is in juvenal plumage and, though it has a slight resemblance to the young of various forms of *oleaginea* it is an obvious member of the *macconnelli* group through its complete lack of the broad, buffy latero-terminal spots on the tertials that are present in both adults and young of the *oleaginea* group.

I have no comparable young of *P. m. amazona* nor of *P. m. roraimae*, but the immature plumage of typical *macconnelli* is much greener on the upper surface, duller and more vinaceous on the belly, and distinctly more clouded on the throat and chest than the type of *peruana* which has the back Medal Bronze X Buffy Citrine and the under parts nearly uniform deep Ochraceous-Buff (tinged with Ochraceous-Orange).

Fortunately two adults are at hand, representing both sexes, from which the full characters of the form may be defined. They are much greener on the upper surface than the young bird but the green has a more yellowish tinge than even in *P. m. roraimae*, being Citrine in the male, Citrine X Warbler Green in the female. The under parts are nearly uniform (as in the young), a little warmer than Yellow Ochre but with the throat and breast only slightly clouded with a faint tinge of Buffy Citrine. The belly thus is paler than in *roraimae* or *amazona*, lighter and clearer than in *macconnelli*, and the whole under parts are more uniform than in any of the others. The male has the two outer primaries modified terminally in a different manner from any other form. These feathers are very slender for 7 mm. (10th primary) and 5 mm. (9th) basad from the tips, then rather abruptly widened. The next two or three primaries have their tips broadly acute with a suggestion of a sinuation in the margin of the narrowing portion. The female has the tip of the 10th primary rather sharply pointed but there is no abrupt change in the contour.

Compared with this feature, *roraimae* has the 10th primary quite slender terminally but with a quite regular acumination.

At its minimum development it is much like it is in the female specimen of *peruana*. Both *macconnelli* and *amazona* may have the tips of the outer primaries somewhat narrowed but apparently never beyond the degree shown by the *peruana* female and often much less.

This modification of the remiges is shown by both sexes though perhaps the males have the most extreme development and it is possible that it reaches its greatest extremes with age. The immature specimens at hand show the minimum modification but various degrees are shown by adults whose possible differences of age are indeterminable.

Two birds from Faro, just north of the lower Amazon, extend the range of *amazona* across the river but there is still a considerable hiatus between the portions of the range in northeastern Bolivia and the right bank of the lower Rio Madeira (Borba) from which no specimens have been reported. The range of *peruana* is separated from that of *amazona*, so far as records indicate, but future collections in the intervening area may succeed in closing the gap.

SPECIMENS EXAMINED

P. m. macconnelli.—

BRITISH GUIANA:

- Kamakusa, 1 ♂, 1 ♀;
- Potaro Landing, 2 ♂;
- Tumatumari, 2 ♂, 1 ♀;
- Rockstone, 1 ♂, 2 ♀, 1 (?);
- Minnehaha Creek, 1 ♀;
- Essequibo River, 1 (?).

FRENCH GUIANA:

- Ipousin, 1 ♀.

P. m. roraimae.—

VENEZUELA:

- Roraima, 2 ♀;
- Arabupu, 1 ♂;
- Mt. Duida, Aguita, 1 ♂, 1 ♀;
- Caño Seco, 1 ♀;
- El Puente, 2 ♀;
- Valle de los Monos, 1 ♂, 1 ♀;
- Cumbre No. 1, Camp. Central, 1 ♀;
- Cumbre No. 2, Cabeceras del Valle, 1 ♂.

P. m. amazona.—

BRAZIL:

- Pará, Prata, 2 ♀;
- Rio Tocantina, Mocajuba, 4 ♂, 5 ♀;
- Cametá, 1 ♂;
- Rio Xingú, Porto de Moz, 1 ♂, 1 ♀;
- Villarinho do Monte, 2 ♂;
- Rio Tapajoz, Limão, 1 ♀;

Igarapé Brabo, 3 ♂;
 Caxiricatuba, 1 ♂, 1 ♀;
 Rio Amazonas, Villa Bella Imperatriz, 1 ♂,
 1 ♀;
 Rio Jamundá, Faro, 2 ♂.

P. m. peruana.—

Perú:

Perené, 1 ♀ (type)¹;
 Chanchamayo, 1 ♂;
 La Merced, 1 ♀.

Pyrocephalus rubinus rubinus (Boddaert)

Muscicapa rubinus BODDAERT, 1783, Tabl. Pl. Enl., p. 42—based on Daubenton, Pl. Enl. 675, fig. 2, and Buffon's "Le Rubin, de la rivière des Amazones"; I suggest Teffé, Brazil, as restricted type locality.

Muscicapa coronata GMELIN (nec Müller, 1776), 1789, Syst. Nat., I (2), p. 932—same basis as *M. rubinus* Boddaert.

Muscipeta strigilata WIED, 1831, Beitr. Naturg. Bras., III (2), p. 900—Camamú, south of Bahia, Brazil; ♀; Amer. Mus. Nat. Hist.

Pyrocephalus parvirostris GOULD, in Darwin, 1839, "Zool. Voy. Beagle," III, pt. 9, p. 44, Pl. VI—La Plata, Argentina; ♂, ♀ from "Buenos Ayres" in British Mus. said to be the "types" [= cotypes].

A good many years ago, Hudson (1888, Birds Argentina, I, p. 152) commented on the fact that this bird was only a summer resident in the southern part of its range, appearing near Buenos Aires about the end of September. He further said that the adults disappeared as early as the end of January, all departing at once but leaving the young behind them. Within a month, the two sexes of the young became distinguishable and after another month the males began to sing, but at the end of April all the young departed.

Even earlier, the migratory habit of the Argentine birds had been noted by such authors as D'Orbigny (1839, Voy. Amér. Mérid., Ois., p. 337) and Gould (*loc. cit.*) while Allen (1892, Bull. Amer. Mus. Nat. Hist., IV, p. 338) later called attention to the fact that the species appeared to be absent from Matto Grosso during part of the year, from October to April.

In confirmation of these assertions I find that all of our Argentine examples (37 specimens) are dated from September (one skin) to April (one skin), mostly from October to January (two dated in March).

¹Specimen in Academy of Natural Sciences of Philadelphia.

Paraguayan birds are dated from March to October, with one quite young individual from near Concepción dated February 27. One bird from Uruguay is dated November 11. Brazil: Rio Grande do Sul—September and October; all other states—April to September. Bolivia—June to October. Eastern Perú—May to October. Southeastern Colombia—July.

The October birds from Rio Grande do Sul, Brazil, are labeled as having the gonads slightly enlarged but it is not certain that they were not still birds of passage. The Uruguayan specimen and the young bird from Paraguay, dated February 27, suggest the probability that the breeding range of the form extends slightly north of the Argentine borders. Barrows (1883, Bull. Nutt. Orn. Club, VIII, p. 201) notes the species as breeding at Concepción del Uruguay in late November and early December, arriving in middle September and leaving in early April. The northern limits of the breeding range have yet to be established in any detail but it seems to be assured that the bird is only a winter visitant to the Tropical Zone of Brazil, Bolivia, eastern Perú, eastern Ecuador, and southeastern Colombia. The original specimen figured by Daubenton and said to be from the Amazon must, therefore, have been a wintering bird.

This matter is of some importance in connection with the recorded occurrence of a distinct subspecies, *P. r. major*, in southeastern Perú. Although this other form is very imperfectly known, as will be discussed separately, it is probably resident and the occurrence of *rubinus* as a migrant or winter visitant in the same region does not affect the validity of the two subspecies.

It is worthy of note that *P. r. rubinus*, a migrating form, tends to have the wing a little more pointed than the non-migratory forms of South America. The tendency is not pronounced enough to be of taxonomic value and is overcome by the individual variations of this form and its relatives. Most of the full-plumaged males of *rubinus* have the tenth (outermost) primary nearer the sixth than the fifth in length, the ninth primary sometimes

longer than the eighth, and the seventh distinctly shorter than the eighth. The more sedentary forms have the tenth a little longer than the fifth or sometimes shorter than the fifth, and the ninth, eighth, and seventh nearly equal to each other, each of them on occasion being the longest.

Peruvian records that presumably belong to typical *rubinus* are from Pebas, Xeberos, Iquitos, "Upper Ucayali" [= near Cashiboya], Lower Ucayali, Huio, Huacamayo, and Yarina Cocha. Bartlett reported it also from Santa Cruz, as quoted by Sclater and Salvin (1873, P. Z. S. London, p. 281), and the record is not improbable although no actual specimen has been listed from that locality. Bartlett's account of the habits of the species, "always on the banks of the river, where it breeds in the holes of dead trees," is so at variance with the known habits of any form of this species that it must be concluded he either made an error in his identification or got his notes regarding some other bird attached to the account of *Pyrocephalus*. In any case, I am unable to accept his statement, on this evidence, that the species breeds on the Ucayali and Huallaga rivers.

There is a record of "*rubineus*" also from Cosñipata, southeastern Perú, which Hellmayr has assigned to *major*, apparently without examination of the specimen and solely on the basis of the occurrence of *major* in the general region. Since the present form also occurs in that region as a migrant, the Cosñipata record (Sclater and Salvin, 1873, P. Z. S. London, p. 186) presumably made in May, June, or July, must be left in abeyance since the present whereabouts of the specimen are unknown to me.

There is also a record from La Merced that needs further investigation since it is the only one from that general region. The bird in question was collected in August, and may, therefore, have been a migrant *P. r. rubinus* although there is a slight possibility that *major* (q.v.) occurs in this vicinity.

Pyrocephalus rubinus obscurus Gould

Pyrocephalus obscurus GOULD, in Darwin, 1839, (July), "Zool. Voy. Beagle," III, pt. 9, p.

45—Lima, Perú; melanistic variety; British Mus.

Myiarchus atropurpureus TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 273—Perú (= hot coastal region); melanistic variety; Neuchâtel Mus.

Pyrocephalus rubineus heterurus BERLEPSCH AND STOLZMANN, 1892, P. Z. S. London, p. 381—Lima and Ica; cotypes in Warsaw Mus. and Amer. Mus. Nat. Hist.

The arrangement of the Peruvian, Ecuadorian, and Colombian specimens of the present species, excluding the migrants of the typical form, is far from satisfactory. Owing to certain seasonal differences in intensity of coloration and of "ageal" differences, some rather definite geographical variations are easily overlooked. As a preliminary measure, however, it becomes necessary to establish the application of certain names that have been assigned to the birds of western Perú.

As will be discussed below, I consider the dark-plumaged "*obscurus*" of Gould to be a melanic "phase" of the resident form of Lima and vicinity and use the name accordingly as the subspecific appellation, since it is the oldest available term for this form. Tschudi's "*atropurpureus*" is another name for the same dark "phase" and, since its type locality was given in rather general terms, I hereby suggest a restriction of it to Lima, where Tschudi's bird probably was collected. Berlepsch and Stolzmann (*loc. cit.*) stated that they considered Lima birds as typical of their "*heterurus*" and I accept Lima as type locality although I have at hand two specimens from their collection, one from Lima and one from Ica, both labeled "typus." These two birds are thus two of the cotypes (or, possibly, paratypes, should it be found that the authors selected any one specimen as a particular "type," which I am inclined to doubt).

I am not thoroughly convinced that the name, *major*, should not be placed in the synonymy of *obscurus*, but it has been used, with some justice, for certain birds from southeastern Perú that may belong to a separable form and since I am unable to offer any proofs to the contrary I have adopted the same arrangement and will discuss the case in greater detail under

the heading of *major*. The other available names, excepting those applicable to the typical subspecies, are all properly restricted to the Lima form.

Non-melanic males from Ica, Ilo, Cochachaca, Vitor, Pisco, and Moquegua average distinctly larger, paler and less sooty on the back, and pinker or rosier red below than those from the Lima region. There is less distinction in the females from these two regions but there is some difference in size and the females from the Lima region usually have a tinge of brownish buff on throat and breast that is lacking in the more southern birds. Farther northward along the coast, in the Libertad and Piura regions, the birds are still smaller and although the males are otherwise not certainly different from the Lima birds (except that no melanic phase is known from this area) the females have the throat whiter and the breast distinctly more narrowly streaked. This character is carried up the coast of Ecuador and into western Colombia.

On the other hand, the species crosses the Western Andes of Perú by way of the Huancabamba Pass and once inside the Marañón Valley, at least east of the Río Huancabamba, there is another noticeable alteration in the character of the population, with the males more fiery red beneath, less rosy, and the females more broadly and intensely red on the abdomen and, less intensely, even over the breast while the throat also has a pinkish tinge.

These various distinctions appear to justify the recognition of several additional forms the descriptions of which will follow.

Even with the limitations here put on the form that bears the name *obscurus*, there is much individual variation in certain respects. For example, there is no constancy in the amount of whitish markings present on the tail. Some examples have the outer web of the outermost rectrix whitish or pinkish but others have it little if any paler than the inner web. The tips of the rectrices also may be conspicuously whitish or pinkish or very narrowly so, and in worn examples these narrow tips may be completely absent.

The rump and upper tail-coverts sometimes show narrow, pale tips. None of these characters appears to have any geographical significance.

Immature birds of both sexes in juvenal plumage are dull brownish above with narrow buffy margins on all the feathers, including the upper wing-coverts. The throat and the middle of the belly are white; the breast and flanks are marked by broad, elongate spots of brown and the under tail-coverts have brown shaft-streaks. The outer margins and tips of the inner remiges are buffy or ochraceous and the outer web of the outermost rectrix is whitish.

The post-juvenal molt may begin rather promptly, at least as early as November, or may not start until April or May. The first winter plumage thus acquired is worn until the season of regular annual molt, from the following November or December to the next April or May.

The first winter plumages of the two sexes are relatively distinct from each other and from the fully adult dresses of the respective sexes. In this dress both sexes lose the juvenal buffy margins of the head and back but may retain some traces of such margins on the upper wing-coverts. The females retain the markings of the breast, sides, and flanks but in the form of streaks rather than spots and at the same time acquire a varying intensity of pink or yellow coloration on the flanks. Sometimes this pink coloration is as deep as in fully adult females but usually it is paler; I am not sure that any fully adult female ever has the flanks yellow. One bird from Paracas Bay, Perú, molting from juvenal to first winter plumage, has advanced far in the molt but shows no more trace of yellowish color on the flanks than very young birds.

Males in first winter plumage have much stronger reddish or orange coloration on the lower under parts than the females of the same age but have the breast similarly broadly striped with brownish. Sometimes there are reddish tips on some of the feathers of the throat and breast but these are not of regular occurrence or position. In addition, the top of the head is extensively red though the brownish

tips of the feathers may conceal this coloration until the plumage is disturbed or may be short enough to leave the red color broadly exposed. Some traces of pale tips on the wing-coverts are still present and certain specimens appear to have retained some of the remiges of the juvenal plumage, which show considerable contrast in color to the fresher feathers of the new plumage.

The first winter plumage probably is worn over the first breeding season and lost in the annual postnuptial molt that occurs from November and December to February or March. One male in this plumage, taken on November 10 at Huaral, Perú, is marked as having the gonads enlarged, indicating possible breeding in this plumage. With the first annual molt, the birds acquire their adult plumage though this may not be exactly the same as that of the still older birds. In the male sex, there may be considerable remainders of the dark tips on the top of the head, some white feathers on the throat and middle of the belly, and even fine, dark streaks on the breast. Specimens with an orange suffusion in restricted parts of the red plumage appear likely to be birds that have only recently reached adulthood.

A very interesting fact concerning the coastal Peruvian forms of this species is the common occurrence of melanism in a restricted portion of the range, from Cocachacra to Huaral. There has been some division of opinion as to the specific distinction of the dark birds from the light ones but I find it difficult to believe that two distinct species are involved.

The melanism is evident in all stages of plumage, juvenal, first winter, and adult. Adult females and males in first annual plumage are lighter, on average, than the adult males. The adult males often have single feathers or portions of feathers, breast, throat, sides, and head, bright red like the plumage of normal adults of that sex. There is also a pronounced purplish red suffusion throughout the plumage of all the birds beyond the juvenal stage, least obscured in the lighter colored individuals like the females and subadult males.

I have been unable to find any definite evidence of the interbreeding of the two supposed phases but I believe it must occur. The dark birds are not found anywhere outside the range of the red ones and although Jelski, quoted by Taczanowski (1884, Orn. Pér., II, p. 312), said that the two occupied different kinds of terrain, I have collected both from the same tree to which they flew together. As contributory evidence, it may be noted that the dark birds from Cocachacra are larger than those from Lima, paralleling the difference of size exhibited by the red series. The unfortunate circumstance is that the oldest name for the coastal birds of Perú was applied to the melanic ones, necessitating the use of the name, *obscurus*, for the entire subspecies, most examples of which are far from obscure in coloration.

Records from Callao belong here without question.

Pyrocephalus rubinus cocachacrae, new subspecies

TYPE from Cocachacra, Province of Arequipa, Perú; sea level. No. 170,537, American Museum of Natural History. Adult male collected June 12, 1920, by Harry Watkins.

DIAGNOSIS.—Similar to *P. r. obscurus* of the vicinity of Lima, Perú, but somewhat larger. Males in red "phase" with back a little lighter, browner and less sooty; red of under parts rosier, less scarlet-hued; outer web of outer rectrix apparently always noticeably whitish. Females in this phase with anterior under parts somewhat clearer whitish, less buffy-tinged.

RANGE.—Coast of southern Perú and northern Chile, from Pisco and Ica to Tacna and Arica.

DESCRIPTION OF TYPE.—Top of head Scarlet Red with fine, brownish tips on a few scattered feathers; back Clove Brown with a few indistinct pinkish tips on the feathers of the lower rump; upper tail-coverts more sooty. Lores whitish, with a narrow dusky superior border and with a blackish anteocular spot; a whitish subocular lunule rather conspicuous; auriculars like the back and the same color extending forward narrowly over the orbit. Whole under parts of body between Spectrum Red and Rose Doree, lightening on the lower under tail-coverts to Geranium Pink; most of the ventral plumage with slight whitish tips, somewhat worn away. Wings about like the back but with indistinctly pale tips on the secondaries and some of the upper wing-coverts; bend of wing with a narrow pink stripe; under wing-coverts about like the back. Tail a little darker brown than the wings, with narrow whitish tips on all the rectrices and with the outer web of the outermost

feathers whitish to the shaft except for a short subterminal space. Bill and feet (in dried skin) dark brown. Wing, 82 mm.; tail, 63; exposed culmen, 13.5; culmen from base, 20; tarsus, 17.

REMARKS.—Female not very different from the normal plumage of *obscurus* in the same sex but with a distinct average of more whitish, less buffy, on throat and breast, paler upper parts, and always noticeably pale outer web of the outer rectrix. In size, there is less obvious difference than between the two series of males but the females of *cocachacrae* average slightly larger than those of *obscurus* (wing, 76–80.5 mm. as against 74–78; tail, 56–63 as against 54–61).

The wing and tail measurements of the males of *cocachacrae* as compared with *obscurus* are as follows: wing, 77.5–84 mm., av., 81 (as against 72–81, av., 76.7); tail, 58–65, av., 61.3 (as against 53–61.5, av., 57.3). However, only four (two melanistic individuals) out of eighteen adult males measured have the wing below 80 mm. and only four (including one melanistic bird) out of twenty-one adult males of *obscurus* have the wing as much as 80 mm. in length.

One male from Cocachacra is very like *obscurus* in coloration (red phase) but is as large as the type of *cocachacrae*. Some young males of *obscurus* in first winter plumage have the back as light as the older males of *cocachacrae* but usually are readily separable by the various characters that distinguish adults of the two forms.

Records that presumably belong to *cocachacrae* are from Tacna, Islay, and Catarindos Valley.

Pyrocephalus rubinus piurae, new subspecies

TYPE from Palambra, Dept. Piura, Perú; altitude 3900–6500 feet. No. 175,424, American Museum of Natural History. Adult female collected September 30, 1922, by Harry Watkins; original No. 6216.

DIAGNOSIS.—Similar to *P. r. obscurus* of the Lima region of Perú but with bill shorter and more slender on average, and not otherwise distinguishable in the adult male plumage although there is never, so far as known, a melanistic "phase." Females average paler in dorsal coloration than those of *obscurus* and have the throat more clearly whitish, less washed with soiled buff, the pectoral streaks narrower and less

prominent, and the bill usually smaller as in the male sex.

RANGE.—Northwestern Perú from Trujillo northward up the coastal region of western Ecuador and Colombia; crossing the Western Andes of Perú to the western side of the Rio Huancabamba; ascending the Western Andes of northern Ecuador to the Quito region; and spreading over the Cauca and Magdalena valleys of Colombia.

DESCRIPTION OF TYPE.—Upper parts largely Benzo Brown × Deep Brownish Drab with centers of the feathers darker, not sharply defined; forehead paler and strongly tinged with pink; upper tail-coverts sooty. Loes and a broad but ill-defined superciliary stripe whitish; auriculars light pinkish brown; subocular space whitish; chin and throat whitish, faintly tinged with the color of the breast; breast light Tilleul Buff with narrow brownish shaft-streaks; sides of breast Shrimp Pink with broader brown shaft stripes; upper part of flanks like the sides but with streaks narrower and color deeper, deepening on the lower flanks and under tail-coverts to Geranium Pink × Strawberry Pink; belly medially broadly whitish, lightly tinged with pale pink. Wings dark brown; outer margins of secondaries and tertiaries and the upper coverts inconspicuously paler, like the back; secondaries and tertiaries and the greater coverts with narrow whitish tips, suggested also on the tips of the other upper wing-coverts; carpal margin rather broadly pink; under wing-coverts near Light Cinnamon-Drab. Tail dark brown with narrow and inconspicuous pale tips on the rectrices but with outer web of outermost feather broadly whitish except near the tip. Bill and feet (in dried skin) blackish. Wing, 73 mm.; tail, 57.5; exposed culmen, 12; culmen from base, 18; tarsus, 17.

REMARKS.—The males are rather variable in color as are those of *obscurus* (although they are not known to have any melanistic "phase"). The back usually is relatively dark but the average hue is perhaps a little lighter than in *obscurus*. The red of the under parts is more variable than in the other forms and is sometimes as rosy as in *cocachacrae*, sometimes as scarlet-red as the deepest *obscurus*. The outer web of the outermost rectrix may or may not be largely whitish, being variable as in *obscurus*. The bill, however, is smaller, on average, than that of either *obscurus* or *cocachacrae* as the following figures show. Thirteen males of *cocachacrae* have the culmen from base measuring 18.1–20.5 mm., average, 19; twenty-seven males of *obscurus*, 17–19.8, average, 18.2; twenty-six males of *piurae* (from Perú), 16.1–18, average, 17.5.

The character of narrow streaking on the chest is shown also by both sexes in first winter plumage. There is one adult female from Trujillo that agrees with the females of *obscurus* in the relatively heavy pectoral marking but the bill agrees better with that of *piuræ* as would be expected.

A male from Virú has the upper tail-coverts unusually broadly tipped with deep pink, about 4 mm. wide. Occasional specimens of one subspecies or another show slight pink or whitish tips of these feathers but the Virú bird has the maximum development of this variation.

I have no hesitation in referring to *piuræ* the birds from the lower elevations of western Ecuador and Colombia, but I am not sure that there may not be some distinctions necessary in other portions of these two countries. Twenty-four males from the coastal region of Ecuador have the wing, 70.75-77.5 mm. in length; the tail, 51-59. Fourteen males from the highlands near Quito (Ibarra, Chillo Valley, Tumbaco, and "Quito") have the wing, 74.5-82.5; tail, 56-63. I can find nothing except this average size, however, on which to claim any differentiation. Colombian females appear to have a little more pronounced red coloration on the belly than those from Ecuador and western Perú but the difference is not positive enough to warrant separation on this character. With some hesitation, therefore, I assign all resident Ecuadorian and Colombian birds (except for Santa Martán records = *saturatus*) to *piuræ*.

Peruvian records that should belong here are from Payta, Pacasmayo, Minocucho, Paucal, Chimbote, Palmal, Lechugal, and Guadalupe, the last three apparently only sight records.

Pyrocephalus rubinus ardens, new subspecies

TYPE from Perico, Río Chinchipe, northern Perú. No. 182,116, American Museum of Natural History. Adult female collected July 16, 1923, by Harry Watkins; original No. 7468.

DIAGNOSIS.—Similar to the normal bright red phase of *P. r. obscurus* of the western coast of Perú in the region near Lima, but females with whole of lower under parts clear red, not broadly whitish on the middle of the belly. Males somewhat more fiery red beneath and on the crest

than those of *obscurus*, with less of a rosy tinge; back more consistently sooty. Both sexes with bill averaging shorter; wing, tail, and tarsus less noticeably so.

RANGE.—More arid portions of middle Marañón Valley, intergrading with *obscurus* between Huancabamba and Palambla.

DESCRIPTION OF TYPE.—Forehead and anterior portion of crown near Sorghum Brown, more strongly tinged with pink near the nostrils; back of head near Benzo Brown, obscurely streaked with darker brown, one feather with inner web largely clear red; back light Fuscous, anteriorly blending with the color of the head; upper tail-coverts darker. Lores dull whitish, with a dusky spot near the eye; superciliary region a little lighter than the crown; auriculars Natal Brown, with a pinkish tinge anteriorly; chin and throat light Salmon-Beige; breast similar but broadly streaked with Verona Brown; sides similarly streaked but ground color tinged with red; belly Scarlet × Peach Red; flanks similar but with traces of dark streaks anteriorly; under tail-coverts a little paler. Wings sooty brown with indistinctly paler margins on the secondaries and suggestions of very fine whitish tips; under wing-coverts brown; bend of wing pink. Tail sooty brown, with fine whitish tips and with outer web of outer rectrices paler than the inner web. Wing, 70 mm.; tail, 54; exposed culmen, 12; culmen from base, 17; tarsus, 16.

REMARKS.—Male with whole under parts and crest near Scarlet-Red; back between Dusky Drab and Blackish Brown (3); lores and auriculars like the back; wings as in the female but more blackish; tail blackish, usually with a strong white or pink terminal mark and with the outer web of the outer rectrices often decidedly whitish or pale pinkish, sometimes not. Wing, 72-79 mm.; tail, 53.5-62. The juvenal plumage is not distinguishable from that of *obscurus*.

I have hesitated to name this form in view of the great variability of *obscurus* and *piuræ*, extreme examples of which come fairly close to *ardens*. Some of the males can not be identified with certainty for this reason, for although the males of *ardens* are noticeably uniform, except in the vicinity of the Huancabamba Pass where they develop the more rosy hue of *obscurus* and *piuræ*, occasional skins from various parts of the range of these other forms possess the scarlet coloration of *ardens*. Of well over a hundred males of *obscurus* and *piuræ* there are not more than eight or ten that match typical *ardens* in this respect and most of the re-

mainder are very distinct. Some apparently adult males of *obscurus* have a certain amount of yellowish suffusion on the throat and breast or even the belly that gives an orange tint to the under parts but this color is again different from that of *ardens*.

The differences in the lengths of the bill and tarsi are not pronounced enough nor constant enough to serve without question, but they are quite useful as corroborative characters. The relative sizes of the bills are more easily determined by observation than by millimetric measurement, owing to the miniature scale required. If bills are placed with their tips and lateral margins together, the relative positions of the adjacent nostrils of each will show that *obscurus* usually has a little longer bill than *ardens*.

In the series of over sixty females of *obscurus* and *piuræ*, only four show any decided approach toward *ardens* and even these are exceeded in intensity of coloration by all but one of the females of *ardens* except three intermediate examples from near the Huancabamba Pass.

A young female from Sondorillo has the lateral under parts light Bittersweet Pink. One from Huancabamba, also not fully adult, has this region a little rosier than Peach Red but a more adult female from Huancabamba has the whole belly and the flanks intense light Scarlet-Red. Two males from Huancabamba and one male from Sondorillo are definitely rosier red than typical *ardens*, agreeing closely with males from Palambra and the coast of Perú. It is apparent, therefore, that intergradation takes place in the neighborhood of the Huancabamba Pass, and that there is no sharp line dividing the two forms at this point.

More puzzling is a male from Chachapoyas that is very like the males from Huancabamba in its rosy tinge. It is marked as having greatly enlarged gonads and was taken on December 18, precluding much likelihood of its being a migrant of *piuræ* if, indeed, there were any other evidence of the migration of the subspecies in Perú. A female from Chachapoyas, however, is a good *ardens* and serves to

establish the identity of the form found in this locality.

There is another apparently important character for the adult males of *ardens* that is useful though not perfectly diagnostic. At the completion of the post-nuptial molt, *obscurus* and *piuræ* more often than not show fine, whitish terminal margins on the feathers of most of the under parts although these wear off before the next breeding season and leave the under parts clear rosy red. Occasional fresh examples may show but few of these tips but such specimens are rare. In male *ardens* there are no such pale tips at any season beyond very minute traces, all but imperceptible, in one or two specimens. In worn examples, of course, this difference is lost.

The two adult males from Huancabamba, mentioned in a preceding paragraph have some of the lateral feathers of the crest very elongate, 28 mm. in one specimen and 27 mm. in the other. No taxonomic significance can be attributed to this variation, apparently, since there is no indication of it in other males from nearby localities. The usual length of the feathers in question is from about 12 to 18 mm.

The pronouncedly red belly of the females of this form strongly suggests the color of *saturatus* of the northernmost regions of South America. Some examples of this sex are very similar, but female *saturatus* reaches a greater extreme in depth of color on the abdomen and usually has heavier stripes on the breast.

Male *saturatus* has much the same hue of red on the under parts as *ardens* but it is a little sootier on the back, on average, and has a shorter wing (69-75 mm.) and tail (50-56.5) without the very obviously pale outer web of the outermost rectrix as shown by some *ardens* though frequently with equally pink tips on the rectrices.

It is thus obvious that *ardens* is decidedly intermediate between *obscurus* or *piuræ* and *saturatus* in spite of the very wide geographic hiatus between the known ranges of *saturatus* and *ardens*. The intervening terrain, largely tropical forest, is not such as might be expected to support

a breeding population of *Pyrocephalus* and the relatively few specimens known from the area appear to be but wintering or migrant examples of *rubinus*. Direct genetic relationship between the two subspecies does not appear very probable and the similarity may be due to parallelism.

Records that should be assignable to *ardens* are from Bellavista, Callacate, Viña, Cajamarca, Succha, Hacienda Limón, and Guajango.

Pyrocephalus rubinus major Pelzel

Pyrocephalus major PELZELN, 1868, Orn. Bras., II, p. 115, footnote—based on "*Pyr. coronatus* or *Muscicapa coronata* of authors" of Gould, in Darwin, "Zool. Voy. Beagle," III, pt. 9, p. 45, in text; locality unknown; Chaquimayo, Perú, suggested by Laubmann, 1930.

There is a serious problem concerning the valid use of the name *major* for any subspecies of *P. rubinus*. Gould described his supposedly new *P. parvirostris* (from La Plata) as being smaller than "*coronatus*," basing his supposition on measurements of "*coronatus*" that were given him by G. R. Gray. These showed that form to have the wing (inches and lines reduced to millimeters), 80.4 mm.; tail, 65.6; bill, 19–21 mm.; tarsus, 15–17 mm. Where Gray obtained these measurements it is impossible to say. In the length of tail and length of bill, the measurements exceed those of true "*coronatus*" (= *rubinus*) and Pelzel, *loc. cit.*, proposed the name *major* for whatever birds Gray might have had that showed the larger measurements. He noted that the Vienna Museum possessed a specimen from an unknown locality that agreed with these measurements and this bird Hellmayr later (1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 5, p. 89) accepted as the type of *major*, although I do not think this acceptance is justified. At the same time, Hellmayr recorded a specimen from Chaquimayo, southeastern Perú (Munich Mus.), and one from Huio, Urubamba region (Field Mus. Nat. Hist.), which agreed with the Vienna Museum specimen in large size, unusually dark back, and lack of white on the outer web of the outermost rectrix. All these birds he referred, provisionally, to *major*. Still later, Laubmann (1930, Deut-

sche Gran Chaco Exped., Vogel, p. 214) proposed for *major* the restricted type locality of Chaquimayo, Perú.

It is futile to try to ascertain where Gray obtained his measurements. The Catalogue of Birds in the British Museum lists no specimens from southern Perú (except of the melanic phase of *obscurus*) that were on hand at the time of the publication of the Zoology of the Voyage of the Beagle. D'Orbigny (1839, Voy. Amér. Mérid., Ois., p. 47) included birds from Lima, Tacna, Bolivia, and Argentina in what he called "*coronatus*" and gave the wing-measurement as 80 mm. (near the maximum for *rubinus*!) but did not mention the bill and tail. This is the nearest approach I can find to Gray's figures. As a matter of fact, the length of tail as given by Gray is approached at all closely only by the birds from southwestern Perú, less closely (but next in average) by specimens from the Lima region, although one bird from northern Ecuador is as large as many southwestern Peruvian specimens.

However, Hellmayr (*loc. cit.*) has noted the three birds, all adult males, which he refers to "*major*," as being especially dark on the upper surface and lacking all decided whitish tint on the outer web of the outer rectrices. The birds from southwestern Perú disagree entirely with this diagnosis. On the other hand, some of the adult males from the neighborhood of Lima lack the white edges on the tail, and, furthermore, a dark back is one of the characters of the Lima form. As noted earlier, specimens from the highlands of northern Ecuador are larger than those from the lowlands of the same country, although I have proposed no taxonomic separation on those grounds, and it is possible that there is a resident population in the highlands of southern Perú with measurements larger than those of *obscurus* of Lima, but otherwise similar.

There thus remains some question as to the actual distinction of a resident form in this inland area. As discussed on a previous page, typical *rubinus* is a winter visitant to this region and the only evidence that there is another and resident form is

the Munich Museum bird from Chaquimayo and the Field Museum specimen from Huio. A record from Cosñipata, placed by Hellmayr under *major*, needs confirmation as noted in the discussion of *rubinus*. In the meantime, since the most positive evidence concerning such a form rests on the Munich Museum skin whose locality has been proposed by Laubmann as type locality of this form, the name *major* may be accepted with reservations for a possible subspecies living in the highlands of southeastern Perú and with characters as defined by Hellmayr.

SPECIMENS EXAMINED

P. r. rubinus.—

ARGENTINA:

Barracas al Sud, Pacheco, Monte Grande, Flores, San José de Flores, La Plata, Monte (Estado San Martino), La Soledad, Mendoza, Suncho Corral, Rosario de Lerma, Avia Terai, Chascomús, Mar del Plata, Tafi del Valle, Los Talas (Buenos Aires), and "Argentina," 26 ♂, 11 ♀.

PARAGUAY:

Puerto Pinasco, Puerto Pazani, Colonia Riso, Río Ipano, opposite Concepción, Mancuello, Makthlawaiya, 80 kilometers west of Pinasco, and "Paraguay," 11 ♂, 1 ♀, 3 (?).

URUGUAY:

Mouth of Río Jaguarao, 1 ♂.

BRAZIL:

(Rio Grande do Sul) Santa Isabel, Palmares, Candiota, and Lagoa dos Patos, 11 ♂, 2 ♀;
(Santa Catharina) Poça Prieto, 1 ♂;
(Paraná) Guayra and Porto Mendez, 5 ♂, 1 ♀;
(São Paulo) Itapura and Victoria, 2 ♂, 1 ♀;
(Bahia) Santa Ritta, 5 ♂; Camamú, 1 ♀ (type of *strigilata*);
(Piauí) Corrente, 4 ♂, 1 ♀;
(Minas Gerais) Rio Jordão, 1 "♀" [= ♂];
(Goyaz) Rio Thesouras and Rio Araguaia, 4 ♂, 3 ♀;
(Matto Grosso) Chapada, Campanario, and Amambary, 26 ♂, 17 ♀, 5 (?);
(Amazonas) Rio Xingú, Victoria, 1 ♀;
Rio Madeira, Humaythá, 5 ♂;
Rio Purús, Bom Lugar, 1 ♀;
Rio Negro, Manaos, 1 ♂, 2 ♀;
Teffé, 3 ♂.

BOLIVIA:

Todos Santos, Mission San Antonio, Reyes, Santa Cruz, Falls of Rio Madeira, Province of Sara, and San Augustin, 15 ♂, 2 ♀.

PERÚ:

Río Tavera, 1 ♂;
La Pampa, 1 ♀;
mouth of Río Urubamba, 4 ♂;
Puerto Indiana, 4 ♂, 6 ♀;
Yurimaguas, 2 ♂¹, 2 ♀¹.

P. r. major.—

PERÚ:

Huio, 1 ♂¹.

P. r. cocachacrae.—

PERÚ:

Cocachacra, 7 ♂ (incl. type), 3 ♂¹, 1 ♀;
Vitor, 3 ♂, 3 ♀;
Moquegua, 3 ♂, 3 ♀;
Paracas Bay, 1 ♀;
Ilo, 1 ♂, 2 ♀, 1 ♀²;
Pisco, 4 ♂, 4 ♀;
Ica, 1 ♂ (cotype of *heterurus*), 2 ♂², 2 ♀, 1 (?);
Tambo Valley, 1 ♀.

CHILE:

Chacalluta, 3 ♂¹, 1 ♀¹.

P. r. obscurus.—

PERÚ:

Lima, 2 ♂, 3 ♀², 1 ♀ (cotype of *heterurus*), 4 ♀²;
Huaral, 18 ♂, 3 ♂², 15 ♀;
Huacho, 12 ♂, 4 ♀, 1 (?);
Chorrillos, 3 ♂, 2 ♀;
Sayán, 2 ♂, 1 ♀;
Vitarte, 5 ♂, 16 ♀², 1 ♂¹, 8 ♀, 8 ♀², 1 ♀²;
Chosica, 1 ♂¹, 2 ♀¹;
Santa Eulalia, 4 ♂¹, 2 ♀¹.

P. r. ardens.—

PERÚ:

Perico, 2 ♂ (incl. type), 1 ♀;
Jaen, 2 ♂, 1 ♀;
Pucará, 1 ♂, 1 ♀;
Saúces, 2 ♂, 1 ♀;
Lomo Santo, 1 ♂;
Santa Rosa, 1 (?);
San Felipe, 1 ♂, 1 ♀;
San Ignacio, 2 ♂, 2 ♀;
Huancabamba, 2 ♂, 2 ♀, 1 (?);
Malca, 2 ♂, 1 ♀;
Chachapoyas, 1 ♂, 1 ♀;
Río Cajamarca, 2 ♀.

P. r. piurae.—

PERÚ:

Palambra, 3 ♂, 3 ♀ (incl. type);
Sondorillo, 1 ♂, 2 ♀;
Virú, 7 ♂, 2 ♀;
Tembladera, 1 ♂;
Trujillo, 6 ♂, 3 ♀;
Milagros, 1 ♀;
Chepen, 1 ♂;
Chilaco, 2 ♂, 2 ♀;
Sullana, 2 ♂, 3 ♀;
Paletillas, 3 ♂;
Píllares, 1 ♂;

¹ Specimens in Field Museum of Natural History, Chicago.

² Dark "phase."

Somate, 4 ♂, 1 (?);

Lamor, 5 ♂, 1 ♀;

Túmbez, 1 ♂, 2 ♀.

ECUADOR:

Guainche, Río Jubones, Casanga Valley,
Santa Rosa, Río Pullango, Río Pindo,
Portovelo, Isla Santay, Guayaquil,
Chone, Esmeraldas, Bucay, Isla Puna,
Duran, Daule, Santa Elena, Isla La
Plata, Chongocito, "Quito," Ibarra,
Chillo Valley, Tumbaco Valley, Quevedo,
and "Ecuador," 51 ♂, 14 ♀.

COLOMBIA:

Cali, Palmira, Cauca, east of Palmira,
Atuncela, San Antonio, Caldas, Honda,
Tumaco, Popayan, Andalucia, Chicoral,

Medellin, Antioquia, Río Caquetá, Los
Coyotes, "Bogotá," and "Sinaloa, Mex-
ico" (errore), 40 ♂, 11 ♀, 2 (?).

P. r. saturatus.—

VENEZUELA:

Altigracia, Ciudad Bolívar, Caicara, Mar-
ipa, "Orinoco," Suapure, La Prición,
Barquimeto, El Cuji, Tucacas, San
Felix, Duaca, Valencia, Quiribana de
Caicara, and Las Guaiacas, 33 ♂, 18 ♀.

BRITISH GUIANA:

Annai, 4 ♂, 1 ♀, 2 (?).

BRAZIL:

Rio Surumú, Frechal, 3 ♂, 2 ♀;

Rio Cotinga, Limão, 1 ♂, 1 ♀.

CORRIGENDA

In No. XXXII of the present "Studies"
(1939, Amer. Mus. Novitates, No. 1044),
pp. 16 and 18, *Scytalopus magellanicus*

obscurus Zimmer (nec *Sylvia obscura* King,
1828) requires a new name. It is hereby
renamed *Scytalopus magellanicus opacus*.

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STUDIES OF PERUVIAN BIRDS. NO. XXXIX¹

THE GENUS *VIREO*

By JOHN T. ZIMMER

I am indebted to the authorities of Field Museum of Natural History, Chicago, the United States National Museum, Washington, D. C., and the Senckenbergian Museum, Frankfurt a. M., Germany, for critical specimens used in the following study.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color Standards and Color Nomenclature."

Vireo olivaceus olivaceus (Linnaeus)

Muscicapa olivacea LINNAEUS, 1766, Syst. Nat., 12th Ed., I, p. 327, part—based on the Olive-coloured Flycatcher of Edwards, Gleanings, p. 93, Pl. xxv; the Red ey'd Flycatcher, *Muscicapa oculis rubris* of Catesby, Carolina, I, p. 54; *Muscicapa jamaicensis* of Brisson, Orn., II, p. 410; I accept the reference to Catesby, following (as first reviser) Baird, 1866, Smiths. Misc. Coll., No. 181, p. 335, with type locality as Carolina.

Vireo vireescens VIEILLOT, 1808, Hist. Nat. Ois. Amér. Sept., I, p. 84, Pl. LIII—no locality; stated to be New Jersey, 1819.

Vireo bogotensis BRYANT, 1860, Proc. Bost. Soc. Nat. Hist., VII, p. 227—Bogotá, Colombia: Mus. Comp. Zool.

Although I recognize the composite nature of the original *Muscicapa olivacea*, I now believe that there is no valid obstacle to accepting Baird's restriction of the name to Catesby's Red ey'd Flycatcher. This procedure has the added value of maintaining a name long in use in preference to one more recently proposed, a change, furthermore, not obligatory under the International Rules of Zoological Nomenclature.

The North American bird ranges in winter over much of northern South America, as far as Bolivia (recorded by Ridgway and Hellmayr, though without details) and the Matto Grosso region of Brazil, crossing the Amazon as far downstream as the Rio Tapajoz. In this winter range it meets several resident forms and also migrants of one of them, *chiri*, in its winter range. This contact with migrant *chiri* is brief and occurs at the time when one of the forms has reached its winter home and just before the other has left for its journey to its breeding range. In the Matto Grosso region, however, *olivaceus* may spend the "winter" with the population of *chiri* that breeds in that area.

In most cases it is not difficult to distinguish *olivaceus* from *chiri* but there is sufficient overlap of characters to necessitate careful examination in certain cases. As a rule, *olivaceus* has the ninth (sub-external) primary distinctly longer than the sixth while *chiri* has the ninth shorter than the sixth, usually shorter than the fifth. Nevertheless, I have various examples of undoubted *olivaceus* from North American localities with the ninth primary shorter than the sixth, coming very close to agreement with the extreme variation of *chiri*. In general coloration, the two forms overlap to a pronounced degree although *olivaceus* apparently never has as bright yellow on the crissum as is found in certain extremes (but not the average individuals) of *chiri*, and there is no distinction of color that is of especial taxonomic value. In size, *olivaceus* usually is larger, with wing 73–85 mm., but *chiri* has the wing 63–74.5 mm. in length, just passing the minimum of the North American form. Thus far I

¹ Earlier papers in this series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 555, 584, 648, 647, 668, 703, 728, 733, 736, 757, 755, 819, 860, 861, 862, 889, 893, 894, 917, 930, 962, 963, 994, 1042, 1043, 1044, 1045, 1066, 1095, 1108, 1109, and 1126.

have not detected a specimen that does not have at least one of its characters distinctive enough to fix its identity as between the two forms in question but the resemblance of the two forms is so great that their specific identity should not be open to question.

Dwight (1899, Ann. N. Y. Acad. Sci., XIII, p. 236) gave an account of the complete postnuptial molt of *olivaceus*, a process that takes place in August and September, before the southward migration, but he stated that the nuptial plumage is thereafter acquired by wear. The material now in hand demonstrates, however, that there is also a prenuptial molt from February to April (possibly starting earlier than February). Nineteen specimens collected in these three months all show replacements occurring throughout the plumage or else with plumage beautifully fresh in contrast to the abraded dress of the birds collected from October to December.

It is impossible to say with certainty just which records of *olivaceus* from Perú belong to that form and which should be transferred to *chiri* since *chiri* was not recognized as a Peruvian bird until 1889. However, three records listed as *agilis* presumably belong to *chiri*. Taczanowski puts all the Peruvian records under *olivaceus* where most of them had been assigned by earlier authors. These include records from Chamicuro, Chayavitas, Huambo, Guajango, Callacate, Pebas, and "Upper Ucayali," and may belong to migrant *olivaceus*, migrant *chiri*, or, if residents, to one of several forms, depending on the locality. The various possibilities will be mentioned in the discussions of the various forms. Two specimens from Huio, from among those from Huio and Maranura that Selater and Salvin assigned to *olivaceus*, are *chiri*; but other examples from the same places may prove to be *olivaceus*. The only records about which there is no doubt are comparatively recent ones from Yahuarmayo and Anco and a much older one from Yurimaguas.

***Vireo olivaceus flavoviridis* (Cassin)**

Vireosyltia flavoviridis CASSIN, 1851, Proc. Acad. Nat. Sci. Phila., V, p. 152—Panamá City

and San Juan de Nicaragua; four cotypes formerly in Acad. Nat. Sci. Phila., now lost.

The original Panamá specimens are said to have been collected by Bell who reported the species as common near Panamá in May. Since the form described as *insulanus* must breed about that time in Panamá, the cotypes of *flavoviridis* probably included some specimens of "*insulanus*." Cassin gives the wing-length of *flavoviridis* as three and two-tenths inches (81.28 mm.), female rather smaller, and since this dimension belongs only to the birds of the northern part of Central America, it is safe to restrict the type locality of *flavoviridis* to San Juan de Nicaragua.

I am not convinced of the advisability of maintaining "*insulanus*." Although Peters (1931, Auk, XLVIII, pp. 575-587) has shown that the birds breeding in the southern part of Central America, from southwestern Costa Rica and Panamá, average less in the length of the wing than birds from northwestern Costa Rica to northern Mexico, it appears that the average wing-length of each of the two supposed forms is within the variational limits of both and that a large proportion of specimens cannot be identified by this measurement. The following figures will show the problem.

I have not sufficient breeding material from the range of "*insulanus*" to give me original measurements for this form but Peters shows that males may have the wing 74-79 mm.; females, 71-78 (I have one female only 68.2 and one 69). Fifty-nine males of undoubted *flavoviridis* have the wing 74.5-83.75; twenty-seven females, 72.5-81. Of this series, twenty-three males and twenty-five females are within the maximum of "*insulanus*," a total of forty-eight out of eighty-six specimens unidentifiable by wing-length alone.

On the other hand, sixty specimens from Panamá and south across Colombia, Ecuador, and Perú to Bolivia, including many migrants in winter quarters, may be grouped as follows on the basis of wing-length.

		"Insu- lanus"	Flavo- viridis	Doubtful
Panamá	26 ♂	7	5	14
	10 ♀	1	0	9
Colombia	2 ♀	1	0	1
Ecuador	3 ♂	0	2	1
	4 ♀	0	1	3
Perú	7 ♂	0	3	4
	6 ♀	0	0	6
Bolivia	1 ♂	0	1	0
	1 ♀	0	0	1
Total	60	9	12	39

Using the measurements given by Peters for *flavoviridis* (differing slightly from my figures) and showing the males with wing 77-83 and females, 73-80, only six additional specimens of the series at hand would come within the restricted measurements of *insulanus* and the number of unidentifiable specimens would be reduced to thirty-three, still well over half of the total. Including the birds from the breeding range of a restricted *flavoviridis*, eighty-seven out of one hundred and forty-six specimens are unidentifiable.

Except for one female from Chicoral, Colombia, with a wing-length of only 69 mm., I have no specimen from anywhere south of Panamá that could confidently be referred to an "*insulanus*" on the basis of size.

I am unable to appreciate the relative prominence of the dusky line between the crown and the superciliary stripe as a character of diagnostic value in the separation of the two forms in question. This border is very variable throughout all Central American specimens and is as inconspicuous in some undoubted *flavoviridis* as in any supposed *insulanus* and, on the other hand, it is quite prominent in some summer birds from Panamá. Ridgway (1904, Bull. U. S. Nat. Mus., L, pp. 132, 147) described this line as heavier in *insulanus* than in *flavoviridis*; Peters (*loc. cit.*) reverses this diagnosis. Ridgway follows Bangs's original description of *insulanus* in crediting this form with duller coloration, but Peters makes no mention of such a character. There is considerable individual variation in intensity of coloration and I am unable to find any regularity in it.

In this connection, three specimens from Perú are worthy of particular mention. In size, wing-formula, and pattern these three birds show unquestionable relationship to *flavoviridis*, but they are very dull in coloration, being less brightly hued, even on the flanks and crissum, than some *olivaceus*. They agree with the description of an intermediate form, *hypoleucus*, under which they are discussed at greater length.

Although typical *flavoviridis* and typical *olivaceus* are very different in coloration, *flavoviridis* has all of its characters matched, at least singly, in such South American forms as *griseobarbatus*, *solimoiensis*, *viridior*, and *agilis*, and through them is in close relationship to *chiri* and *olivaceus*. In addition, the wing-formula of *flavoviridis* more nearly equals that of *olivaceus* than does that of any of the South American resident forms. In one extreme of development, the ninth (subouter) primary is fully as long as the sixth; in the other extreme it is no longer than the fifth. In *olivaceus*, the ninth may be longer or shorter than the sixth or subequal to it.

In final analysis, therefore, I find the distinctions between *flavoviridis* and "*insulanus*" too much overcome by individual variation to enable me to recognize both subspecies and I place "*insulanus*" in the synonymy of *flavoviridis*.

Records from Perú, all wintering birds, are from Huaynapata, Río Cadena, Monterico, Guajango, and Iquitos.

One Peruvian specimen, from Puerto Indiana, sexed as a female with gonads not enlarged, is dated May 27 but I am not sure that the date is correct. The plumage of the specimen is somewhat worn whereas in May it should be relatively fresh. Like *V. o. olivaceus*, this subspecies has a complete postnuptial (or incomplete post-juvinal) molt on its breeding grounds in August or thereabouts. On the other hand, wintering specimens taken from February to April usually show a molt of the wings and tail and often of at least parts of the head and body, and occasional skins from Central America of the same dates show the last vestiges of the replacement of wing and tail feathers. As in typical *olivaceus*, therefore, there appear to be an

incomplete postjuvénal molt, a complete postnuptial molt, and an incomplete pre-nuptial molt.

***Vireo olivaceus hypoleucus* van Rossem
and Hachisuka**

Vireo olivaceus hypoleucus VAN ROSSEM AND HACHISUKA, 1937 (Sept. 30), Proc. Biol. Soc. Wash., L, p. 159—San Francisco Cañon, eastern Sonora, Mexico; ♂: Dickey Coll., Calif. Inst. Technology.

I have no topotypical material of this form and one specimen from Escuinapa, Sinaloa, that might be expected to belong here because of the locality, cannot be distinguished from numerous examples of *flavoviridis*.

However, three specimens from Perú (two from Santa Rosa, Río Ucayali, and one from Río Távora, southeastern Perú) are markedly distinct from all other specimens of a large series from the breeding and winter ranges of *flavoviridis* in the manner ascribed to *hypoleucus*. In all respects, except for the weak stripes in the superciliary region, these three Peruvian birds are exactly intermediate between *flavoviridis* and *olivaceus*; the superciliary stripe and its dark upper border are as in *flavoviridis*. With this characterization, the three Peruvian birds probably belong to *hypoleucus*. That form has been known to be migratory and has been found in El Salvador while on migration but the winter home was not known. With the evidence here discovered, it is apparent that the winter range coincides, in part, with that of *flavoviridis* which I have also from Santa Rosa and Río Távora.

One item in the original description of *hypoleucus* is puzzling. The lateral under parts and under tail-coverts are said to be yellower, less greenish, than in *flavoviridis*. Any approach toward *olivaceus* would need to show the reverse of this since *olivaceus* is much greener and less yellowish in those parts than *flavoviridis*, which is the case in the three birds from Perú that I assign tentatively to the northwest-Mexican form.

On the other hand, van Rossem and Hachisuka (*loc. cit.*) mention certain skins from Tamaulipas that they found even closer to *olivaceus*. None of the Tamaulipas birds I have is of this nature but it is

possible that there may be an area of intergradation between *flavoviridis* and *olivaceus* in northeastern Mexico from which my three birds may have traveled. Much more must be done before the status of the population in the whole of northern Mexico is fully understood. In the meantime, there is a name for an intermediate form that is apparently applicable to the three migrants in hand.

***Vireo olivaceus forreri* Madarász**

Vireo forreri MADARÁSZ, 1885, Termész. Füzetek, IX, p. 85, Pl. 11—Tres Marias Islands; Hung. Nat. Mus.

I have nothing to add to the meagre information available about this bird except to note that a specimen from the Lawrence Collection, credited to "Ecuador" as a locality and "Alexander" as a collector, appears to belong to it. The wing is just over 81 mm. and the tail is 57, both measurements within the extremes of *flavoviridis*, but the superciliary markings are obsolete and the bird agrees well with five topotypical skins of *forreri*. If this assignment is correct and the locality of the specimen is authentic, we have here the first indication of the possible winter home of this insular form.

***Vireo olivaceus chivi* (Vieillot)**

Sylvia chivi VIEILLOT, 1817, Nouv. Dict. Hist. Nat., nouv. éd., XI, p. 174—based on the "Contra-maestre del Gavero," Azara, II, p. 37, No. CLII—Paraguay = 24° - 36° S. lat., 57° - 60° long. W. of Paris = western Paraguay.

In view of the fact that Paraguayan birds of this species are rather variable and show a tendency in part toward the birds of northern Argentina and in part toward those of southeastern Brazil, the fixation of the name *chivi* on one or the other elements of the Paraguayan mixture becomes highly important.

Baird (1866, Smiths. Misc. Coll. 181, p. 338) found birds from various localities in South America showing two degrees of brightness in the yellow coloration of the sides and lower under parts and retained the name *chivi* for the duller of the two, *agilis* for the brighter, although he did not have a great deal of material on which to establish the limits of individual variation

and restricted ranges. Much later, Berlepsch (1889, Jour. fur. Orn., XXXVII, p. 294) speaks of the paler western form to which he concludes the name *chivi* must be restricted, in distinction from *agilis*. Since mere restriction of type locality may not suffice to establish a restricted identity for *chivi*, I propose that "*Sylvia chivi* Vieillot" be recognized as identical with the birds of the Tucumán region of Argentina; i.e., with dull and relatively grayish-olive back, strong, blackish lines on either side of the crown, and relatively pale yellowish or even whitish flanks and under tail-coverts.

Birds of this sort are fairly consistent in northern Argentina, west of the Río Paraguay, and in southern Matto Grosso where they undoubtedly breed, and some of the Paraguayan birds, particularly those from northwestern localities, are in excellent agreement with the north-Argentine specimens. In northern Matto Grosso, an occasional specimen shows much more decided yellow on the under tail-coverts, on the flanks, and in a suffusion of the olive back, and these birds, also, are of such dates of collection that they must represent the breeding population in one extreme of its individual variation. Even with the yellow suffusion on the back and the bright yellow crissum and lateral under parts, these brighter birds are not precisely like *agilis* from more eastern parts of Brazil. The back of *agilis* is bright, but it is a greenish olive rather than yellowish and does not have the brownish or grayish tinge that dulls the dorsal color of the northern Matto Grosso series. Furthermore, there is no clear separation of these birds from *chivi* but rather a complete intergradation such that while the extremes are very different, a large number of specimens are equivocal.

It is true that the brightest examples are all from the more northern part of central Brazil and westward across northern Bolivia to central and southeastern Perú, but there are still brighter subspecies along the southern banks of the Amazon toward which these bright *chivi* may be considered as showing a trend. In any case, I am not quite convinced that any subspecific dis-

tinctions should be made in this entire series from central Perú to Matto Grosso, northwestern Argentina, and northwestern Paraguay.

There is abundant evidence that *chivi* is migratory from a considerable part of its breeding range. Aside from the fact that I have seen no specimens from this area collected between April 9 and August 31, I have numerous examples from localities within the ranges of other forms, extending as far northward as the Orinoco and showing various dates between March 17 and August 28, once as late as November 19. Many of these specimens show the grayish and whitish tones of the Argentine birds; some are a little brighter and may have come from the more northern breeding populations. Localities for these migrants will be listed among the specimens examined.

Some of the specimens from Bolivia and southern and central Perú are exactly like the northwest-Argentine birds and may be migrants from Argentina, but more show the brighter coloration of the north-Matto Grosso series. These, I believe, are part of the breeding population. It is impossible, however, to distinguish clearly between the two sets and it is quite possible that the entire series includes only members of a single population in its two extremes. There are present bright-backed birds with nearly white under tail-coverts and as dull-backed examples with the crissum strongly yellow, as well as regularly dull or brightly colored individuals.

This is the form that approaches *olivaceus olivaceus* so closely in every respect that a specimen combining certain extremes of color, size, and wing-formula would be quite unidentifiable, except perhaps by locality and date, not necessarily conclusive. A specimen of *olivaceus* is at hand from Chapada, Matto Grosso, dated February 14, and there are numerous specimens of *chivi* from the same locality covering various dates between September and April, including three February specimens. Likewise there are specimens of both subspecies from the upper Orinoco taken in March and April, from the Río Tapajoz in March, from eastern Ecuador in No-

vember, and *chivi* in late August on the Rio Negro with *olivaceus* in the same region in early September—all instances of migrants of one from North America meeting, or nearly meeting, migrants from the South Temperate Zone on common ground, the winter home of both forms and, in many cases, the year-long home of still another form.

There seems to be little seasonal variation in the intensity of coloration of *chivi*. Some abraded examples still have the under tail-coverts decidedly yellowish; others have the region whitish. The differences are about the same as are shown by fresh examples, although very worn specimens, as is to be expected, have a generally duller appearance due to wearing away of some brighter parts of the feathers.

I am unable to get a very clear picture of the molt of *chivi* owing to certain irregularities for which I have not found the explanation. The form apparently breeds between October and February, possibly varying the actual time somewhat according to locality, earlier in the northern part of the breeding range. At the end of this period, some examples show considerable wear of the plumage but others are not very badly abraded. The first positive signs of prenuptial molt in the material at hand are shown in June specimens, more prominently in July birds, but there are evidences of molt in advanced stages through August and September. One specimen collected at Chapada. Matto Grosso, on November 11, is in postjuvenile molt, replacing head and body feathers and wing-coverts but not the remiges and rectrices. A second specimen from the same locality, dated in January, has nearly completed a molt, possibly also postjuvenile. A skin from Urucum, dated November 29, has the wings and tail quite fresh but has not lost quite all of the juvenile feathers on the back. It is quite possible that the examples in unworn plumage that are dated from February to May are young birds that have completed their postjuvenile molt. I have seen no certain adults in molt at this time except for occasional changes of a few scattered feathers that may have been accidentally lost, appar-

ently not in regular molt. None of the Argentine specimens at hand shows any regular molt.

A confusing feature of the plumage in numerous specimens is that the tertials and median pair (occasionally also the adjacent pair) of tail-feathers often are in a decidedly different condition of wear than the rest of the quills. If the wing and tail are in generally fresh condition, these inner feathers may be quite abraded or the opposite condition may be true. Such evidence as I can find suggests that these inner feathers are the first to molt, preceding the others by a sufficiently long period that they may be slightly worn before the rest of the molt begins. Probably most of the series of *chivi* shows so little difference in the amount of wear exhibited by the different series of quills that the distinction is not easy to determine at first glance. I have been unable to find a specimen of *chivi* actually molting the inner quills, but these feathers are comparatively fresher than the others in March, April, May, and June examples, comparatively more worn in birds taken during the breeding season (once in a July skin). From this it appears possible that there is a very modest postnuptial molt involving only the inner feathers of wing and tail, perhaps in February and March, months rather poorly represented in the series before me.

Dwight reported the postjuvenile molt of typical *olivaceus* as sometimes involving the tertials but not the rest of the wing. However, the specimens of *chivi* that I have with inner remiges and rectrices fresher than the remainder of wing and tail appear to be fully adult whereas the specimens with the remiges and rectrices of equal freshness often show some signs of immaturity. One of the birds in the last stages of postjuvenile molt is replacing the entire wing and tail along with the contour plumage. In other birds in the same molt, these feathers are quite fresh. The sequence of plumages in *chivi* thus involves an incomplete postjuvenile molt; the first winter plumage; a partial prenuptial molt of all but the inner remiges and rectrices; a partial postnuptial molt of only the inner remiges and rectrices. The inner flight-

feathers of the first winter plumage thus appear to be worn for over a year without replacement—probably the reason why these feathers sometimes show such an extreme condition of abrasion in contrast to the moderately worn state of the remaining plumage. Afterward, although the two sets of feathers are molted at different seasons, each is replaced once annually.

I have two specimens of *chiri* from the Rio Seco, west of Moyobamba, and there are records from Anco, Yahuar Mayo, and Yurimaguas that are presumably correctly assigned. Records of "*olivaceus*" from Chamicuro, Chayavitas, Huambo, and "Upper Ucayali" may belong to *chiri* which was not recognized by the recorders. Specimens from Guajango and Callacate, and from Pebas may have been migrant individuals of *chiri* or may have been residents of the separate forms occupying the respective areas as discussed on later pages.

Vireo olivaceus agilis (Lichtenstein)

Lanius agilis LICHTENSTEIN, 1823, Verz. Doubl. Berliner Mus., p. 49—Bahia: Berlin Mus.

Vireo bartonii SWAINSON in RICHARDSON, "1831" = Feb., 1832, Faun. Bor.-Amer., II, p. 235—Brazil and "South Carolina"; type from Brazil, lat. 12° S. in Mus. Univ. Cambridge, England.

The restriction of the name *chiri* to the pale birds of western Paraguay, northwestern Argentina, and adjacent regions, leaves the name *agilis* available for the brightly colored population of Bahia and contiguous territory. In comparison even with the brighter Matto Grosso and Peruvian specimens of *chiri*, the series of *agilis* presents certain distinctions that are prominent and fairly constant. The top of the head is clearer, lighter gray in *agilis*; the superciliary stripe is more purely whitish; the dark lines bordering the sides of the crown are a little less heavy; the sides of the breast, the flanks, and the under tail-coverts are clearer and brighter yellow; the outer margins of wing and tail are brighter and yellower.

Birds of this sort occupy the coastal region of Brazil south to the neighborhood of Rio de Janeiro and northward to the

Pará district, thence ranging westward along the south bank of the Amazon to the region between the Madeira and the Tapajoz rivers and crossing the Amazon to the neighborhood of Faro. In this western area there apparently is some intergradation with *chiri* although it is confusing owing to the fact that *chiri* migrates to, or through, this region. The intermediate specimens may be migrants from some area of intergradation between Matto Grosso and the Amazon or this zone of intergradation may lie exactly where these specimens were obtained. Future studies in the field should determine this point.

The birds from the state of Rio de Janeiro are not uniform, if three specimens (one a "Rio" trade skin) are characteristic. The trade skin and one bird from the Organ Mountains are nearest *agilis* but a specimen from Mt. Itatiaia is more like the birds from São Paulo and farther south. In this southeastern corner of Brazil, the population differs from both *agilis* and *chiri* sufficiently to deserve separate recognition, and since there is no available name for such a subspecies, it may be known as follows.

Vireo olivaceus diversus, new subspecies

Type from Roca Nova, Paraná, Brazil; altitude 930–1150 meters. No. 504,979, American Museum of Natural History. Adult male collected October 12, 1901, by A. Robert; original No. 669.

DIAGNOSIS.—Nearest to *V. o. agilis* of Bahia, Brazil, but with upper parts darker and duller; top of head Mouse Gray instead of Neutral Gray; back with a brownish tinge; superciliary stripe buffy instead of purer whitish; auriculars duller, more buffy olive than greenish; throat and breast often with a slight buffy tinge, less purely whitish; size averaging a little larger. Differs from *V. o. chiri* of western Paraguay by decidedly greener upper parts, sides, and flanks and more yellowish crissum; darker auriculars; less purely whitish superciliary stripe; and larger size.

RANGE.—Southeastern portion of Brazil from São Paulo to Rio Grande do Sul: Uruguay; possibly reaching extreme eastern Argentina and eastern Paraguay; it may be, in part, migratory as detailed elsewhere.

DESCRIPTION OF TYPE.—Top of head Mouse Gray carried over the hind neck and merging gradually into the color of the back; mantle Dark Citrine × Dull Citrine, brightening posteriorly to Serpentine Green on the rump

and upper tail-coverts. A prominent superciliary stripe near Tilleul Buff, with a strong blackish line separating it from the crown, both stripes reaching to the base of the bill; a dusky line across the lower part of the lores and a similar but less sooty postocular stripe; a buffy whitish subocular lunule; auriculars near Deep Olive-Buff anteriorly, darker and more brownish posteriorly; malar region Light Drab; chin, throat, and breast whitish, tinged with Tilleul Buff; belly whitish; sides of breast Light Yellowish Olive; flanks brighter, near Olive Yellow; under tail-coverts near Barium Yellow. Remiges dark brown, exteriorly margined with Yellowish Olive; upper wing-coverts like the mantle but greater series finely margined with light yellow; under wing-coverts, axillars and inner margins of remiges Barium Yellow X Chalcedony Yellow; tail dark brown with a greenish tinge and with outer margins of the feathers like the rump; inner margins narrowly yellowish, more clearly defined toward the tips of the outer three pairs of rectrices. Maxilla (in dried skin) light brownish; mandible pale slaty; feet dark slate. Wing, 75 mm.; tail, 54.5; exposed culmen, 12.5; culmen from base, 18; tarsus, 17.5.

REMARKS.—Females like the males in color but averaging smaller; wing 68–71.5 mm. (♂, 69–76.5); tail, 48–53.5 (♂, 50.5–56.25).

Occasional specimens resembling this form are at hand from several localities unquestionably beyond the breeding range of the subspecies and it is impossible to say whether they actually belong to *diversus* or whether they are unusually dark though greenish examples of *chivi*. All of them, only nine skins, are dated between late February and October, and most of them are a little duller than the average skin of *diversus*, but they are a better match for the series of that form than for the series of *chivi*. All of the specimens of *diversus* from southeastern Brazil are dated between the end of September and early April and it seems likely that this subspecies also is migratory, at least in part. Consequently, the eight birds from outside the breeding range of this form may be considered for the present, at least, as migrant individuals of *diversus*.

I have mentioned earlier that the birds from the state of Rio de Janeiro appear to represent both *diversus* and *agilis* although a series, greater than I have at hand, will be necessary to determine the range of each in this state. With the meagre material

available, it would appear that *agilis* occupies most of the state but that *diversus* crosses the border from São Paulo in the neighborhood of the Serra do Itatiaya.

A similar problem exists in the vicinity of La Plata and Buenos Aires where there is a slight suggestion of the characters of *diversus* in the local population, although the greater resemblance is to *chivi* to which I have referred specimens from that region. Birds from Uruguay, eastern Paraguay, and Misiones, Argentina, agree best with *diversus*.

Vireo olivaceus solimoënsis Todd

Vireo caucæ solimoënsis Todd, 1931 (July), Auk, XLVIII, p. 412—São Paulo de Olivença, Rio Solimões, Brazil, ♂; Carnegie Mus.

The population on the south bank of the Amazon, westward from the left bank of the Rio Madeira, is recognizably distinct from *agilis* by a number of characters. The size averages smaller, particularly the lengths of tail and bill (♂, wing, 64–69 mm.; tail, 40–46; culmen from base, 15.25–17.75; ♀, wing, 60–64; tail, 40–42.5; culmen from base, 16–17); the coloration of the back is somewhat yellower and brighter; the top of the head is usually a little paler gray; and the dark line above the whitish superciliary stripe is decidedly weaker, often obsolete and at best not very blackish but, rather, sooty gray; the auriculars usually are grayish rather than light citrine. A single specimen from Rosarinho, on the left bank of the Rio Madeira, has this dusky line better marked than usual and one skin from Puerto Indiana, Perú, is similarly distinguished. Specimens from both banks of the lower Rio Negro, Brazil, are a little more strongly marked in this respect than most of the birds from south of the upper Amazon and reach a very little greater extreme of size (♂, wing, 64–69; tail, 42–47; exposed culmen, 16.5–17.5; ♀, wing, 62–64.5; tail, 40.25–43; culmen from base, 15–17.75) but agree so well in most respects that they fall easily into this subspecies.

The same agreement is not shown by a series of specimens from Faro which I have discussed under *agilis* and *viridior*.

The Puerto Indiana specimen recorded

herewith is the first example of *solimoensis* known from Perú. The early record of "*olivaceus*" from Pebas may belong here but it may belong properly to *olivaceus* or may be a migrant *chivi*. The form is likely to be found on the lower Ucayali but our collectors failed to find it there.

Vireo olivaceus vividior Hellmayr and Seilern

Vireo chivi vividior HELLMAYR and SEILERN, 1913 (Dec. 5), Verh. Orn. Ges. Bayern, XII, p. 315—Caparo, Trinidad; ♂; Munich Mus.

Vireo roraimae CHUBB, 1921, Birds Brit. Guiana, II, p. 393—Roraima [Venezuela]; British Mus.

The birds from northernmost Brazil, the Guianas, the whole of Venezuela, Trinidad, and the Santa Marta region of northern Colombia appear to represent a single, variable, but indivisible, subspecies. For this form, the earliest name is *vividior*. In general, *vividior* is characterized by relatively bright, often yellowish, green back; moderately light gray crown; broad whitish superciliary stripes, quite broad and white over the lores though sometimes distinctly grayish over the auriculars, and separated from the gray crown by a prominent blackish stripe; size relatively large, with the bill especially long (♂, wing, 66–77 mm.; tail, 45–57.25; culmen from base, 16.5–20.25; ♀, wing, 64.5–71; tail, 43–51.5; culmen from base, 17–19). The gray of the crown usually is carried well over the hind neck, as it is also in *solimoensis* but not in *agilis*, *diversus*, nor *chivi*, but occasional specimens have this gray area shorter and the hind neck more nearly the color of the back. This feature is variable, however, and I have been unable to find it of service as a diagnostic character.

The color of the back also is variable. Some specimens from throughout the range have a duller olive mantle than the others, but in general the back is brighter and yellower than it is in *agilis*. The duller birds are found even on Trinidad, the type locality of *vividior*, as well as in other parts of the range.

I am puzzled as to the proper disposition of the birds of French Guiana, that have been separated under the name

griseolus. There is no doubt that at least some specimens from that country have the under parts overlaid with a light grayish wash more pronouncedly than birds from other regions. Nevertheless, some examples are not as strongly marked in this respect as are others and are not unlike specimens from Mt. Roraima, Venezuela, once separately described as "*roraimae*," or even occasional skins from the type locality of *vividior*. Most specimens of *vividior* have very definite gray on the lateral under parts though I have seen none that equals the extreme of "*griseolus*." One "Cayenne" trade skin at hand certainly cannot be distinguished from the average Venezuelan bird. Likewise three skins from the Rio Surumú, Brazil (Rio Branco region) and one British Guianan specimen are *vividior* and not "*griseolus*." It would appear, therefore, that if "*griseolus*" is to be maintained, its range cannot extend far beyond the bounds of French Guiana. Since there is an evident extreme development of grayish shading below in birds from this restricted region, *griseolus* may be recognized pending more complete knowledge regarding the distribution of the form.

Specimens from Faro, on the north bank of the Amazon, have been mentioned on a preceding page in the discussion of *agilis* to which they belong. They are somewhat closer to *vividior* than typical Bahian specimens but as a series agree best with the Bahian subspecies. The strong blackish lines above the pale superciliary stripes prevent their inclusion in *solimoensis*. In this critical region north of the Amazon there is direct intergradation of *solimoensis*, *agilis*, and *vividior*. Single specimens, in fact, may show apparent identity with the form of an outlying area, as mentioned for the birds of Faro, but there are numerous intergrades linking these extreme individuals with the rest of the population. I have, consequently, allocated the ranges according to the complexion of each series as a whole.

Hellmayr and Seilern (*loc. cit.*) assign a specimen from Marabitanas, upper Rio Negro, to *vividior*. I have no specimens from this general region, except migrant

individuals of *chiri* and *olivaceus*, but with a series from the neighborhood of Mt. Duida assignable to *viridior*, the upper Rio Negro may well belong in the range of the same form.

Lack of year-round material from any single locality and the probability that breeding and molting seasons may vary according to locality prevent a very exact statement regarding the molt of *viridior*. In the series from Santa Marta, numerous specimens indicate an incomplete postnuptial molt in July and August and, apparently, a complete postnuptial molt at the same time. May, June, and July specimens are relatively worn, July birds sometimes fresher than might be expected, and birds taken in January and February are fresh but without evident molt. On the other hand, skins from the region of Mt. Duida show a full molt at various dates from October to March.

The study of the molts in the entire species is complicated by the fact that there is no seasonal difference and very little "ageal" distinction. Juvenal birds are drab above, silky white below, like *oliva ceus*. This plumage is speedily changed to the first winter plumage that is much like that of the adult though averaging brighter in dorsal coloration. The wings and tail also are much like those parts of the adult, averaging brighter on the margins and with the feathers softer in texture and frequently, especially the rectrices, narrower and more acute at the tips. They are carried over from the juvenal plumage and are barely, if quite, developed when the postjuvenal molt begins and are hence in no need of replacement at this time. There is every sort of intermediacy, however, and it is not always possible to tell a first winter bird from an adult. If the wing and tail are in full molt, however, it is fairly safe to conclude that the bird is adult, though possibly just leaving the first winter plumage. Occasionally, by accidental loss, the flight-feathers may be changed with the postjuvenal molt but this is very exceptional.

Vireo olivaceus griseolus (Todd)

Vireosylva chiri griseola TODD, 1924 (July 8), Proc. Biol. Soc. Wash., XXXVII, p. 124—Pied Saut, French Guiana; ♂; Carnegie Mus.

This form, apparently restricted to French Guiana, is not of unquestioned authenticity. Some discussion of its characters has been given in the treatment of *viridior*, on a preceding page. Compared with specimens of *viridior* from northern and western Venezuela and from Santa Marta, Colombia, there is good distinction but if the comparison is made with Trinidad birds (topotypical *viridior*) and specimens from Mt. Roraima ("*roraimae*" = *viridior*), the characters are not so pronounced.

Vireo olivaceus tobagensis Hellmayr

Vireo virescens tobagensis HELLMAYR, 1935 (Sept. 16), Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 8, p. 144—Island of Tobago; ♂; Field Mus. Nat. Hist.

The dull back, large size (including relatively heavy bill), paler under tail-coverts, and heavy, blackish lateral crown-stripes, separate this insular form from the subspecies of Trinidad and the mainland of South America.

Vireo olivaceus caucæ (Chapman)

Vireosylva chiri caucæ CHAPMAN, 1912 (July 23), Bull. Amer. Mus. Nat. Hist., XXXI, p. 159—Cali, Cauca, Colombia; ♂; Amer. Mus. Nat. Hist.

This subspecies is very like *chiri* in its dull coloration and some specimens are difficult to distinguish. In general, however, *caucæ* is darker than *chiri* and has the auricular region more consistently grayish, though many *chiri* agree in this latter respect.

The extent of the range in Colombia needs further study when more material is available.

Vireo olivaceus griseobarbatus (Berlepsch and Taczanowski)

Vireosylva chiri griseobarbata BERLEPSCH and TACZANOWSKI, 1883, P. Z. S. London, p. 541—Chimbo, western Ecuador; ♂; Warsaw Mus.

This form resembles *viridior* in many respects, especially in the color of the back although this area appears to reach a somewhat lighter grayish extreme in the west-Ecuadorian birds. Many examples, however, are equally brightly yellowish green dorsally. The dark lines bordering the

crown laterally may average a little heavier in *griseobarbatus*. On the under parts, the west-Ecuadorian form has the flanks less noticeably grayish but more broadly and strongly yellowish. The size averages a little smaller (♂, wing, 65-71.5; tail, 45.5-52.5; culmen from base, 16-18.25; ♀, wing, 62.5-69.5; tail, 44-47.5; culmen from base, 17-19) but there is considerable overlap as there is between various other forms.

The amount of bright yellow exhibited on the under parts by the brightest examples is as much as is shown by various specimens of *flavoviridis*, although the upper parts, the lateral crown-stripes, and the measurements are very different in the two forms. In these respects, other subspecies show greater resemblance to one or the other.

The dusky mystacial stripe ascribed to this form by the original describers is no more than a slightly dusky shading of the entire malar region such as is found in certain examples of various other forms of the species. Perhaps the type may have a faint indication of fine, blackish tips on a few feathers in the malar line as exhibited by a bird from the Isla La Plata, but this is too inconspicuous to have led to any emphasis on it as a taxonomic character. There is no resemblance to the *alticola* style of marking. A paratype from Chimbo, kindly lent me several years ago by the authorities of the Frankfort Museum, agrees perfectly with other west-Ecuadorian specimens in the series now before me.

In northern Perú, in the middle Marañón Valley, between the Central and Western Andes, there is a population that has been referred by authors to *griseobarbatus* or *chivi* but which belongs properly to neither. Since it is recognizably distinct it may be known as follows.

Vireo olivaceus pectoralis, new subspecies

TYPE from Pucará, Río Huancabamba, northern Perú; altitude 2850 feet. No. 186,051, American Museum of Natural History. Adult male collected September 26, 1924, by Harry Watkins; original No. 8612.

DIAGNOSIS.—Nearest to *V. o. griseobarbatus* of western Ecuador from which it differs by

having the throat and breast noticeably tinged with grayish buff, rather sharply defined from the white on the middle of the belly; auriculars duller, more grayish olive, less citrine; flanks less broadly and brightly greenish or yellowish; under tail-coverts usually deeper yellow (when *griseobarbatus* approaches *pectoralis* in this respect the sides and flanks are proportionately brighter than usual); size averaging larger; back usually darker and duller green; lateral borders of crown more narrowly blackish.

RANGE.—Middle Marañón Valley of northern Perú.

DESCRIPTION OF TYPE.—Top of head between Neutral Gray and light Mouse Gray; a broad superciliary stripe, extending from the nostrils to above the posterior half of the auriculars, whitish anteriorly, tinged with pale gray posteriorly; this stripe separated from the gray of the top of the head by a narrow blackish line; lores, below the superciliary stripe, dusky gray; postocular space a little paler gray. Malar region light Mouse Gray, noticeably darker than the throat; a whitish subocular lunule; auriculars anteriorly pale grayish, posteriorly Grayish Olive. Back between Yellowish Olive and Yellowish Citrine, noticeably (but not very sharply) defined from the gray of the nape; rump and upper tail-coverts a little brighter than the mantle. Chin, throat, and breast buffy Smoke Gray, rather sharply defined from the pure white of the belly; sides of the breast dull Light Yellowish Olive; flanks, where largely concealed by the closed wings, Light Yellowish Olive X Yellowish Citrine; exposed portion of the flanks slightly washed with grayish; under tail-coverts between Citron Yellow and Amber Yellow. Remiges Chaetura Drab with outer margins Primrose Yellow or Naphthalene Yellow; under wing-coverts and axillars Citron Yellow X Amber Yellow; bend of wing Marguerite Yellow; upper wing-coverts Chaetura Drab with the outer margins of the lesser and median series like the mantle, the outer margins of the greater series Light Yellowish Olive (Olive Yellow on extreme outer edge), of the primary-coverts dark Yellowish Olive, and of the alula Citrine Drab; rectrices dull Yellowish Olive with outer margins Light Yellowish Olive and inner margins Barium Yellow. Wing, 73 mm.; tail, 53; exposed culmen, 12.75; culmen from base, 18; tarsus, 18.

REMARKS.—Two birds from Río Seco, west of Moyobamba but east of the Central Andes, do not belong to this form but are distinctly closer to *chivi* although one of them has the under tail-coverts brighter than the other and may show a trend toward the Marañón Valley form. Compared with *chivi*, *pectoralis* is brighter green on the back, more intensely yellow on the crissum, brighter on the outer edges of wing and tail, more decidedly buffy on the

pectoral region, and usually has a longer and more slender bill.

It is interesting to note that the range of the species is carried from western Ecuador to the Middle Marañón Valley, leaving the western side of the Western Andes of Perú apparently untenanted, in much the same manner as I have described for *Elaenia flavogaster*. (Cf. Amer. Mus. Novitates, No. 1108, p. 1.)

In certain ways, *pectoralis* links *chiri* with *griseobarbatus* but shows less direct relationship to *solimoiensis* with which it is connected through *viridior* and the intermediate population of the Rio Negro.

The records from Bellavista and Perico undoubtedly belong to *pectoralis*. Records of "*olivaceus*" from Guajango and Callacate, if referring to resident birds, should belong to *pectoralis* but may actually be migrants of *chiri* or *olivaceus*. Stolzmann noted their differences from Huambo birds but without the specimens it is impossible to assign the records correctly.

SPECIMENS EXAMINED

V. o. olivaceus.—

UNITED STATES:

(large series from numerous localities).

GUATEMALA:

Panajachel, 1 ♂;
Vera Paz, 1 (?);
"Guatemala," 4 (?).

NICARAGUA:

Matagalpa, 1 ♀;
Volcan de Chinandega, 1 ♂.

COSTA RICA:

Bonilla, 1 ♀;
Miravalles, 1 ♂, 1 (?).

PANAMÁ:

(Cocoplum, Wilcox Camp, Río Calovevora, Almirante, Boquete, Cebaco Is., Brava Is., and Panamá Railroad), 10 ♂, 4 ♀.

COLOMBIA:

Santa Elena, 1 ♀;
Villavicencio, 1 ♀;
Chicoral, 1 ♂;
Buritaca, 1 ♂;
"Bogotá," 6 (?).

VENEZUELA:

Mérida, 1 ♂, 1 (?);
Culata, 1 ♀;
El Valle, 1 ♂, 1 ♀, 1 (?);
El Escorial, 2 ♀;
Sierra Nevada, 1 ♂;
Río Orinoco, Nericagua, 2 ♂;
mouth of Río Ocamo, 1 ♀;
Boca de Sina, Río Cunucunumá, 2 ♀;
Mt. Duida, Esmeralda, 3 ♂, 2 ♀;
Playa del Río Base, 8 ♂, 4 ♀, 2 (?);

Footfalls Camp, 1 ♀;
Valle de los Monos, 1 ♂, 2 ♀;
Pié del Cerro, 2 ♂;
Río Pescada, 1 ♀;
Caño Seco, 1 ♀.

ECUADOR:

Río Suno, above Avila, 1 ♀;
lower Río Suno, 3 ♂, 3 ♀;
mouth of Río Curaray, 4 ♂.

PERÚ:

Río Negro, west of Moyobamba, 1 ♂, 1 ♀.

BRAZIL:

Rio Negro, Santa Maria, 1 ♂, 2 ♀;
Muirapinimá, 1 ♀;
San Gabriel, 2 ♂;
Rio Tapajoz, Aramanay, 1 ♂, 1 ♀;
Matto Grosso, Chapada, 1 ♂, 1 ♀.

V. o. forsteri.—

MEXICO:

Tres Marias Islands, Maria Madre, 4 ♂,
1 (?).

ECUADOR:

"Ecuador," 1 (?).

V. o. flavoviridis.—

MEXICO:

Tamaulipas (Victoria, Tampico, and Nixtencatl), 3 ♂;
Sinaloa, Escuinapa, 1 (?);
Tépica, Real de la Yesca, 1 ♂;
Vera Cruz, Paso del Toro, 1 ♂;
Nuevo Leon (Boquilla, Boque Negro, and San Pedro Mines), 8 ♂, 3 ♀;
Jalisco (Guadalajara, Barranca del Lago, Salsipuedes, and La Laja), 4 ♂;
Tehuantepec, Santa Efigenia, 1 ♂;
"Mexico," 1 (?).

GUATEMALA:

(Panajachel, Finca El Cipres, Progreso, Finca Sepacuite, Carolina, La Perla, Hacienda California, Finca Chamá, Alta Vera Paz, and "Guatemala"), 29 ♂,
28 ♀, 5 (?).

NICARAGUA:

(León, Volcán Viejo, and Matagalpa),
5 ♂, 3 ♀, 1 (?).

COSTA RICA:

(Agua Caliente, Miravalles, San José, Buenos Aires, Mt. Aguacate, Bebedero, Aquinares, Irazú, and Las Cañas), 19 ♂,
8 ♀.

PANAMÁ:

[Juan Mina = Alhajuela, Boquete, Cebaco Is., Santa Fé (Veraguas), Wilcox Camp, Agua Dulce, La Colorado (Santiago), Chitrá, Almirante, Chiriquí, Balboa, (Lion Hill), Corozal, Saboga Is., San Miguel Is., San José (Pearl Islands), Pedro Gonzales (Pearl Islands), Cerro Montoso, Cerro Largo, and "Panamá"],
27 ♂, 10 ♀, 1 (?).

COLOMBIA:

Chicoral, 2 ♀;
"Bogotá," 1 (?);
Santa Marta, Bonda, 1 ♂, 6 (?);
Buritaca, 1 ♂.

ECUADOR:

- El Loreto, 2 (?);
 lower Río Suno, 2 ♂, 3 ♀;
 below San José, 1 ♂, 2 ♀;
 mouth of Río Curaray, 1 ♂, 1 ♀;
 mouth of Lagarto Cocha, 1 ♂.

PERÚ:

- Astillero, 1 ♀;
 Candamo, 1 ♂, 1 ♀;
 La Pampa, 1 ♂;
 Río Távora, 1 ♂;
 Río Ucayali, Santa Rosa, 1 ♂, 3 ♀;
 Perené, 1 ♂;
 Puerto Indiana, 1 ♀.

BOLIVIA:

- Tres Arroyos, 1 ♂;
 mouth of Río San Antonio, 1 ♀;
 Prov. Sara, "High Forest," 1 ♀.

V. o. hypoleucus.—

PERÚ:

- Río Ucayali, Santa Rosa, 1 ♂, 1 ♀;
 Río Távora, 1 ♂.

V. o. caucæ.—

COLOMBIA:

- Cali, 1 ♂ (type), 2 ♀;
 Palmira, 1 ♀;
 east of Palmira, 1 ♂;
 Las Lomitas, 1 ♂;
 Caldas, 1 ♂;
 Los Cisneros, 1 ♀;
 Media Luna, 1 ♀;
 "Yuntas" (? = Juntas de Tamaná), 1 ♂;
 "Bogotá," 2 (?).

V. o. griseobarbatus.—

ECUADOR:

- Chimbo, 1 ♀ (paratype)¹;
 Mindo, 4 ♂, 1 ♀;
 Esmeraldas, 3 ♀;
 Intag, 2 ♀;
 Paramba, 2 ♂, 1 ♀;
 San Nicolas, 1 ♂;
 Gualea, 1 ♂, 1 ♀;
 San Javier, 1 ♂;
 Salado, 1 ♂;
 Portovelo, 2 ♂;
 Pullango, 1 ♂;
 Cuaque El Destino, 2 (?);
 Chone, 1 ♂;
 Bahía de Caraquez, 1 ♂;
 coast of Manaví, 1 ♀;
 Chongon Hills, 1 ♂;
 Isla La Plata, 3 ♂, 3 ♀;
 Isla de Puna, 1 ♂, 1 (?).

V. o. pectoralis.—

PERÚ:

- Pucará, 1 ♂ (type), 1 ♀;
 Huarandosa, 1 ♂, 1 ♀, 1 (?);
 Perico, 2 ♂, 2 ♀;
 San Ignacio, 2 ♂, 2 ♀, 1 (?);
 Sauces, 1 ♂, 1 ♀;
 Jaen, 1 ♂, 2 ♀;
 Lomo Santo, 1 ♀;

Hacienda Limón, 2 ♀.

V. o. chiri.—

PERÚ:

- Río Seco, west of Moyobamba, 1 ♀, 1 (?);
 Tulumayo, 2 ♂, 2 (?);
 Huíro, 1 (?);
 Maranura, 1 ♂;
 Idma, 1 ♂;
 Santa Ana, 1 ♂, 1 ♀;
 San Miguel, 1 ♂, 1 (?);
 San Miguel Bridge, 2 ♂;
 La Pampa, 1 ♂;
 Río Távora, 4 ♀;
 San Ramón, 1 ♂;
 Vista Alegre, 1 ♀;
 Huachipa, 1 ♂, 1 ♀.

BOLIVIA:

- Vermejo, 1 ♂, 1 ♀;
 mouth of Río San Antonio, 1 ♂;
 Yungas, Cochabamba, 1 ♀;
 Mapiri, 1 (?);
 Camp-woods, Prov. Sara, 1 ♀;
 Camp, 750 m., Prov. Sara, 1 ♂;
 Todos Santos, 1 ♂;
 Buena Vista (Santa Cruz), 1 ♀.

ARGENTINA:

- Embarcación, 3 ♂, 3 ♀;
 above San Pablo, 2 ♂;
 Tapia, 1 ♂;
 Rosario de Lerma, 1 ♂;
 Barracas al Sud, 1 ♂, 1 ♀;
 Tigre, Buenos Aires, 1 ♂;
 La Plata, 1 ♀.

PARAGUAY:

- Zanja Morotí, 3 ♂;
 east of Caaguasú, 3 ♂;
 east of Tumbes, 1 ♀;
 upper Iguazú River, 1 ♂;
 Puerto Pinasco, 1 ♂;
 "Paraguay," 1 ♂.

BRAZIL:

- Matto Grosso, Barão Melgaço, 1 ♀, 1 (?);
 Utiarity, 1 ♂;
 Tapirapóan, 1 ♂, 1 ♀;
 Belvedere de Urucum, 2 ♂;
 Urucum, 3 ♂, 2 ♀, 1 (?);
 Corumbá, 2 ♂;
 Caxirá Mirim, 1 ♂;
 Chapada, 13 ♂, 6 ♀, 1 (?);
 Rio Machados, Jamarýsinho, 1 ♀;
 Rio Madeira, Porto Velho, 1 ♀, 1 (?);
 Borba, 3 ♂, 7 ♀;
 Igarapé Auará, 1 ♂;
 Rosarinho, 1 ♂;
 Villa Bella Imperatriz, 1 ♂;
 Rio Tapajoz, Aramanay, 2 ♂, 3 ♀, 1 (?);
 Igarapé Brabo, 2 ♀;
 Rio Xingú, Tapará, 1 ♂;
 Rio Grande do Sul, Sinimbu, 2 ♂;
 Rio Negro, Manaus, 1 ♂;
 Yucabí, 3 ♀, 1 (?);

¹ Specimen in Senckenbergian Museum, Frankfurt a. M., Germany.

² One female exchanged with Senckenbergian Museum, Frankfurt a. M., Germany.

³ Specimens in Field Museum of Natural History, Chicago.

⁴ Specimen in U. S. National Museum, Washington.

Tatú, 2 ♂, 3 ♀;
Rio Taupés, Ianarete, 2 ♀, 1 (?);
Tahuapunto, 1 ♀.

VENEZUELA:

Río Cassiquiare, Solano, 3 ♀, 1 (?);
mouth of Río Ocamo, 1 ♂, 1 ♀;
opposite mouth of Ocamo, 1 ♂;
Buena Vista, 1 (?);
Mt. Duida, Píe del Cerro, 1 ♀;
Río Oumoco, Suapure, 1 ♂.

ECUADOR:

mouth of Río Curaray, 2 ♂;
below San José de Sumaco, 1 ♀.

V. o. *diversus*.—

BRAZIL:

Paraná, Roca Nova, 6 ♂ (incl. type), 2 ♀;
Guayra, 1 ♀, 2 (?);
Poito Almeida, 2 ♂, 3 ♀;
Corvo, 4 ♂, 2 ♀, 2 (?);
São Paulo, Ubatuba, 1 ♀;
Itapura, 1 ♂;
Fazenda Cayóá, 2 ♂;
Estação de Rio Grande, 2 ♂;
São Sebastião, 1 ♂;
Rio de Janeiro, Mt. Itatiaya, Monte Serrat
1 ♂;
Rio Grande do Sul, Nonohay, 3 ♂, 2 ♀,
1 (?);
Lagôa Vermelha, 2 ♂;
Erebango, 1 ♂, 1 (?);
Sananduva, 1 ♂;
Sinimbu, 4 ♂;
São Francisco de Paula, 5 ♂, 2 ♀, 1 (?);
Lagôa de Forno, 1 ♂, 1 ♀;
Matto Grosso, Chapada, 3 ♂¹;
Rio Tapajoz, Igarapé, Amorin, 1 ♀¹;
Igarapé Brabo, 1 ♀¹.

URUGUAY:

Rocha, Lazcano, 1 ♂, 1 ♀;
Rocha, San Vicente, 4 ♂.

ARGENTINA:

Misiones, Río Paraná, 1 ♂², 1 ♀²;
Caraguatay, 3 ♂²;
Iguazu, 3 ♂²;
Puerto Segundo, 1 ♂²;
Eldorado, 1 ♂², 1 ♀².

PARAGUAY:

Abai, 2 ♂, 1 ♀, 2 (?).

V. o. *agilis*.—

BRAZIL:

Rio de Janeiro, Organ Mts., La Raiz, 1 ♀;
"Rio" trade skin, 1 (?);
Bahia, Bahia, 3 ♂, 2 ♀, 1 (?);
Tambury, 1 ♂;
Rio Gongogy, 1 ♂, 1 (?);
Bôa Nova, 1 ♂;
Orobó, 1 ♂;
"Bahia" trade skin, 1 (?);
Espírito Santo, Baixo Guandú, 1 ♂, 1 ♀;
Ceara, Joazeiro, 1 ♂, 1 ♀;
São Pedro, 1 ♂;
"Ceara" trade skin, 1 (?);
Goyaz, Rio Araguaia, 1 (?);

Maranhão, Ilha São Luiz, Anil, 2 ♂;
São José, 2 ♂, 1 ♀;
Rosario, 1 (?);
Parnahyba, 1 ♂;
Codó, 1 ♂;
As Mangueiras, 1 ♂;
Pará, 1 ♂;
Isla Marajo, Fazenda Teso S. José, 1 ♀;
Rio Tocantins, Baião, 1 ♂, 1 ♀;
Mocajuba, 5 ♂, 2 ♀;
Rio Xingú, Porto de Moz, 1 ♂, 1 ♀;
Tapará, 1 ♀, 1 (?);
Rio Tapajoz, Santarem, 1 (?);
Igarapé Brabo, 1 ♂, 2 ♀, 4 (?);
Igarapé Amorin, 1 ♀;
Aramanay, 1 ♂, 1 ♀, 1 (?);
Rio Amazonas, Villa Bella Imperatriz,
4 ♂, 1 ♀;
Rio Jamundá, Faro, 1 ♂, 2 ♀;
São José, 3 ♂, 1 ♀;
Serra do Espelho, 2 ♂, 1 ♀;
Castanhal, 2 ♂;
Boca R. Paratucú, 2 ♂, 1 ♀;
Lago Uaimy, 1 ♂, 1 ♀;
Maracana, 2 ♂.

V. o. *solimoiensis*.—

BRAZIL:

Rio Madeira, Rosarinho, 1 ♀;
Rio Amazonas, Teffé, 7 ♂, 4 ♀;
Rio Negro, Manaos, 17 ♂, 8 ♀;
Muirapinimá, 2 ♂, 2 ♀;
Igarapé Cacao Pereira, 17 ♂, 13 ♀, 2 (?).

PERÚ:

Apayacu, 1 ♂.

ECUADOR:

mouth of Río Curaray, 1 ♀.

V. o. *griseolus*.—

FRENCH GUIANA:

Pied Saut, 1 ♂;
Cayenne, 1 "♀" [♂ = ♂];
"Cayenne" trade skin, (?).

V. o. *viridior*.—

TRINIDAD:

Princetown, 5 ♂, 2 ♀;
Pointe Gourde, 1 ♂;
Caparo, 1 ♂, 3 ♀.

MONOS ISLAND, 1 ♂.

VENEZUELA:

Cristóbal Colón, 12 ♂, 3 ♀;
Cocallar, 1 ♀;
San Antonio, 2 ♂, 2 ♀;
Rincón San Antonio, 1 ♂, 1 ♀;
Barbacoa, 1 (?);
Puerto La Cruz, 1 ♂;
Cumanacoa, 1 ♂;
Plain of Cumaná, 1 ♂, 1 ♀;
Sal-si-puede, 2 ♂, 4 ♀;
Campos Alegre Valley, 1 ♂;
inland from Puerto Cabello, 1 ♂;
Quebrada Seca, 1 ♂;
Ejido, 1 (?);
San Esteban Valley, 1 ♂;
Rio Orinoco, Caicara, 5 ♂, 1 ♀;
Suapure, 2 ♂, 1 ♀;
Altigracia, 1 ♂;
Ciudad Bolívar, 2 ♂, 2 ♀;

¹ Placed here with a query.

² Specimens in Field Museum of Natural History, Chicago.

Lalaja, 1 ♀;
 Ayacucho, 1 ♂, 1 ♀;
 Mt. Duida, Caño León, 1 ♂;
 Playa del Río Base, 2 ♂;
 Cerros de Savana, 1 ♂;
 Esmeralda, 1 ♀;
 [western] foot of Duida, 1 ♀;
 Río Caura, La Unión, 2 ♂, 3 ♀;
 La Prisión, 2 ♀, 1 (?);
 Maripa, 2 ♂, 3 ♀;
 Mérida, 4 (?);
 El Valle, 2 ♂, 2 (?);
 Escorial, 1 ♂, 1 ♀;
 Mt. Roraima, 1 ♂, 1 ♀;
 Arabupú, 2 ♂.

BRITISH GUIANA:

no other locality, 1 (?).

COLOMBIA:

Santa Marta, Bonda, 15 ♂, 1 ♀, 15 (?);
 Cacagualito, 1 ♂, 1 ♀, 1 (?);
 Quebrada Concha, 1 ♀, 1 (?);
 Santa Marta, 1 ♀;
 N. Santander, Cúcuta, 1 (?).

BRAZIL:

Rio Surumú, Frechal, 3 ♂.

V. o. tobagensis.—

TOBAGO:

Plymouth, 2 ♂, 1 ♀;
 Mariah, 1 ♂, 1 ♀;
 Mondiland, 2 ♂;
 Lecito, 1 ♂;
 Richmond, 1 ♂;
 Waterloo, 1 ♂;
 Castare, 2 ♂, 2 ♀;
 Tobago, 7 ♂, 2 ♀, 1 (?).

Vireo gilvus leucophrys (Lafresnaye)

Hylophilus leucophrys LAFRESNAYE, 1844, Rev. Zool., p. 81—Colombia = Bogotá region; Mus. Comp. Zool.

Vireo g. leucophrys is exemplified by the birds from the Eastern Andes of Colombia, as is in accordance with the geographical position of the type locality. Compared with specimens from the Central and Western Andes of the same country, the eastern birds are distinctly more brownish on the back and have also a browner tone on the top of the head without the little tinge of drab that is present in the western examples. Old "Bogotá" skins show this to the most pronounced degree but fresher specimens also are recognizable on this character. The whitish throat patch is relatively restricted in the birds from both these areas in noticeable contrast to the more extended white area in *mirandae* of northern Venezuela and *josephae* of west-

ern Ecuador. The lower under parts are variable but often relatively deep yellow, again in contrast to the paler yellow belly of *mirandae* but not certainly distinguishable from the west-Colombian birds in this respect.

Examples from the Mérida region of Venezuela agree in most respects with the east-Colombian birds but have the belly more regularly deep yellow. Specimens from Santa Marta, Colombia, on the other hand, agree in general except that the belly is rather regularly at the pale extreme of coloration. Nevertheless, in comparison with *mirandae*, I believe both the Méridan and Santa Martan series belong with *leucophrys* rather than with the north-Venezuelan form, though extensive series of perfectly fresh examples from all the areas under consideration might show the desirability of breaking up this population into several units.

The differences in intensity of yellow on the lower under parts do not appear to be due to any differences in the antiquity of the specimens but may sometimes be due to relative degrees of wear or abrasion of the plumage. Some of the oldest skins have the belly as deeply yellow as more recently collected specimens. On the other hand, there is much individual variation in this respect to the extent that an occasional specimen of a number of the different subspecies of the group is exceptionally grayish on the back, dark grayish on the cap, and relatively whitish below. This variation I have been unable to associate with any factors of distribution or taxonomic distinction.

Three skins from eastern Ecuador agree fairly well with the east-Colombian specimens and carry the range of *leucophrys* southward along the eastern face of the Eastern Andes to near the Peruvian boundary. Similarly, five birds from the Junín region of central Perú are so similar that I refer them also to the same form together with a specimen from Chinchao which I collected some years ago. Numerous skins from the Western Andes of northern Perú, between the Marañón and this cordillera and on the western side of the same range, are neither *leucophrys* nor *josephae*

¹ Specimen in Cúcuta Museum.

² Specimens in Field Museum of Natural History, Chicago.

as will be discussed on a later page. On the other hand, a single bird from La Lejía, east of the Middle Marañón, is not referable to this western form but agrees better, though not completely, with *leucophrys* to which it may be provisionally referred. The top of the head is not quite so definitely brownish, nor is the back, but the dorsal coloration is relatively light in tone and the general appearance much like that of a bird from San Agustín, Colombia.

Records from Garita del Sol and Paltaypampa, Junín, presumably belong with *leucophrys*. Urubamba Valley specimens, however, show a tendency toward the Bolivian *laetissimus* as will be discussed under that form.

I follow the most recent treatment of *leucophrys* in considering it a subspecies of *gilvus*. Ridgway long ago [1872, Amer. Jour. Sci., (3) IV, p. 456] suggested this relationship because of the intermediate characters presented by birds from Orizaba, Mexico, later described as *Vireo amauronotus* by Salvin and Godman (1881, Biol. Cent. Amer., I, p. 193). Recently, two forms have been described from other parts of Mexico as being intermediate, in different degrees, between *amauronotus* and the gray-backed forms nearest *gilvus* [*Vireo gilvus connectens* van Rossem, 1940 (April 30), Trans. San Diego Soc. Nat. Hist., IX, p. 77—Chilpancingo, Guerrero, Mexico; *Vireo gilvus eleanorae* Sutton and Burleigh, 1940 (July), Auk, LVII, p. 399—six miles north of Jacala, Hidalgo, Mexico]. With this evidence, there seems to be no good reason to keep *leucophrys* and *gilvus* specifically apart. The pattern throughout the various forms here brought together is uniform and the only differences of importance lie in the variable preponderance of gray, brown, or greenish olive on the back, the depth and tone of the color on the top of the head, the amount of yellow on the under parts, and the extent and purity of white on the throat. The various degrees of difference in these factors in varying combinations furnish the bases for the taxonomic distinctions that appear to be tenable.

The distribution of the various forms in Middle America is very imperfectly known and is in need of more careful study than I

am able to give it with the limited material available from that region. There is a hiatus between the demonstrable range of *chiriquensis* and that of the nearest representative of the species in Colombia. There is no known resident form in Nicaragua, Honduras, El Salvador, Guatemala, or British Honduras although *gilvus* and *swainsonii* reach Guatemala and El Salvador in winter. In Mexico, six different subspecies have been distinguished whose type localities are situated, respectively, in Chiapas, Guerrero, Vera Cruz, Hidalgo, Baja California, and Chihuahua. The Vera Cruz and (presumably) the Chiapas forms are unquestionably closest to *chiriquensis* and its South American allies; the Chihuahua form seems to be nearest to *swainsonii*; the two others are intermediate, as noted above. The limits of the range of each of these forms has yet to be determined and it is not beyond hope that some of the existing gaps in the specific range outside of Mexico will also be closed by future collections.

Vireo gilvus laetissimus (Todd)

Vireosylva leucophrys laetissima Todd, 1924 (July 8), Proc. Biol. Soc. Wash., XXXVII, p. 124—Incachaca, Bolivia; ♂; Carnegie Mus.

Five birds from Bolivia, four from the type locality of *laetissimus*, show reasonable distinction from *leucophrys* by reason of their lighter caps which are less brownish than in *leucophrys* and less contrasting with the back which, in turn, is also less brownish and more greenish than in *leucophrys*. The under parts are rather paler yellow and the white of the throat is a little more broadly extended over the upper chest though not as pronouncedly as in *josephae*, *mirandae*, or *chiriquensis*.

Specimens from the Urubamba Valley and southeastern Perú approach this form in respect to the reduction of brownish coloration of the back and the increase of white on the lower throat, and some of the specimens also show the paler yellow under parts and a slightly lighter cap. They are not strictly referable to *laetissimus* but are different from the Junín (and other) specimens of *leucophrys* and may be as-

signed to the Bolivian form to which they show the nearest approach.

Vireo gilvus josephae Sclater

Vireo josephae SCLATER, 1859, P. Z. S. London, p. 137, Pl. CLIV—Pallatanga, western Ecuador; ♂, ♀ cotypes in British Mus.

The birds of western Ecuador are distinguished from those of adjacent parts of most of Colombia, eastern Ecuador, and Perú by their dark caps (usually dark *Chaetura* Drab), dark olive backs, and extensive white area on the throat, usually carried well over the chest where, however, there may be some yellowish edging or flammulation. The extent of this white usually is as great as in *mirandae* although the latter form has a distinctly paler cap.

This form is almost restricted to western Ecuador. Hellmayr (1935, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, part 8, p. 156) assigned a skin from Ricaurte, southwestern Colombia, to this form as may, indeed, be justifiable; my notes on the specimen, made some years ago, specify the color of the cap as darker than in other Colombian skins examined at the same time. However, I do not believe that Palambla, Perú, belongs in the range of *josephae*. A number of specimens from that locality are recognizably distinct from *josephae* as well as from *leucophrys* and agree better with the birds from the Middle Marañón Valley, between the Western and Central Andes of northern Perú. These birds are, in a sense, intermediate between *josephae* and *leucophrys* as might be expected from the geographical position of their range but they constitute a relatively compact population with characters as constant as those of any of the other recognized forms and differ, as such, from another intermediate population in central and western Colombia. To call both these intermediate populations by the same name or to refer them to one or another of the forms to which they approximate would obscure their distinctions as well as their relationships. Accordingly, I believe that both populations should be given separate names as detailed below.

With this treatment, there are no records from Perú that can be assigned to *josephae*.

Vireo gilvus maranonicus, new subspecies

TYPE from Chaupe (near San Ignacio, Río Chinchipe), northern Perú; altitude 6100 feet. No. 181,593, American Museum of Natural History. Adult male collected February 3, 1923, by Harry Watkins; original No. 6908.

DIAGNOSIS.—Similar to the lighter examples of *V. g. josephae* of western Ecuador in respect to the color of the back but with the top of the head not so dark, the yellow of the under parts averaging deeper, and the whitish gular area less purely white, with more of a yellowish tinge, and more restricted in extent, not spreading over the chest. Differs from *V. g. leucophrys* of eastern Colombia by more greenish, less brownish back and darker cap, less brownish and more drab in tone.

RANGE.—Both sides of the Western Andes of northern Perú, but not crossing the Marañón to its right bank.

DESCRIPTION OF TYPE.—Top of head dark Hair Brown, a little lighter on the forehead but somewhat dusky along the sides where there is a tendency to the formation of a dark stripe; back a little lighter than Dark Greenish Olive, grading into the color of the cap on the hind neck but with a number of dark streaks on the upper border of the mantle. A conspicuous white superciliary stripe reaching the base of the bill but darkening to Light Drab above the posterior half of the auriculars; a brownish spot immediately in front of the eye; auriculars and sides of neck largely Hair Brown, passing into whitish on the malar and subocular regions, continuous with the white of the lores; chin and throat whitish, faintly tinged with light yellowish, stronger posteriorly; breast and lower under parts somewhat more chrome-tinged than Citron Yellow, more intense on the flanks. Wings dull blackish (brownier on the tertials) with narrow outer margins of remiges Yellowish Olive becoming whitish toward the tips of all but the outer four primaries; median and lesser upper wing-coverts much like the back; greater series with outer margins light yellowish olive; inner margin of remiges narrowly yellowish white; under wing-coverts bright yellow like the flanks; outermost primary well developed, 17 mm. in length; tail dusky brown with outer margins of feathers Yellowish Olive and with inner margins light yellow, broadest on the outer feathers. Maxilla (in dried skin) dark brown; mandible paler; feet slaty. Wing, 68 mm.; tail, 47; exposed culmen, 11; culmen from base, 14.1; tarsus 17.1.

REMARKS.—Females similar to the males in color but with shorter wing and tail on average. Wing, 61.5–65 (♂, 64.5–68); tail, 44.5–48 (♂, 48–52).

One specimen from Taulis and one from Seques are notable by reason of a particularly grayish tone of olive on the back (near Deep Grayish Olive) and quite pale yellow

under parts. One other *Taulis* specimen has a tendency in the same direction but a similar variation is shown by certain examples of *josephae* and appears to be of no taxonomic significance. Other specimens from *Taulis* and *Seques* are of normal dorsal coloration and nearly normal on the under parts. One male from *Seques* has a strong rufescent coloration on the forehead due, apparently, to stain by some unknown material, traces of which are to be seen on some of the feathers of the chin.

The specimens from Palambra show an occasional trend toward *josephae* by reason of a slightly darker cap or a little more extensive white on the lower throat, but their closer affinity is with the birds from just across the cordillera to the eastward.

A single specimen from La Lejia, east of the Middle Marañón, differs from *maranoncus* by its lighter coloration on the dorsal surface and is referred provisionally to *leucophrys* under which I have mentioned it on a preceding page.

Records presumably assignable to *maranoncus* are from Tabaconas and Tambillo.

Vireo gilvus dissors, new subspecies

TYPE from Cerro Munchique, west of Popayan, Colombia; altitude 7000 feet. No. 109,938, American Museum of Natural History. Adult male collected June 8, 1911, by W. B. Richardson.

DIAGNOSIS.—Differs from *V. g. leucophrys* of eastern Colombia by slightly darker cap of a more grayish, less warmly hued, brown; back distinctly greener, less brownish olive; under parts not distinctive. Differs from *V. g. josephae* of western Ecuador by somewhat lighter colored cap, paler and more greenish-olive back, and more restricted white throat patch with stronger yellowish flammulations on its lower portion. Differs from *V. g. chiriquensis* of Panamá by duller and more greenish-olive back and paler yellow under parts. Differs from *V. g. maranoncus* of north-central and northwestern Perú by lighter cap, paler and duller (often more greenish) back, and lighter yellow under parts.

RANGE.—Central and Western Andes of Colombia in the middle portion, not reaching Santa Elena.

DESCRIPTION OF TYPE.—Top of head Hair Brown × Chaetura Drab; back Yellowish Olive × Citrine Drab, shading into the color of the cap on the hind neck; chin and throat whitish with slight yellowish flammulations on the lower portion; breast and belly Barium Yellow × Naphthalene Yellow, a little deeper on the flanks but with a brownish tinge on the

sides of the breast; outer margins of remiges and rectrices Yellowish Olive × Dull Citrine; the dark lateral borders on the crown are nearly obsolete; the whitish superciliary stripe is only a little duller over the auriculars; otherwise, the pattern and colors are as described for *V. l. maranoncus*. Wing, 64.5 mm.; tail, 44.5; exposed culmen, 10.5; culmen from base, 15; tarsus, 17.

REMARKS.—Females similar to the males in color but averaging smaller. Wing, 64–65 mm. (♂ 64–68); tail, 44–46 (♂, 44–47).

A series of fifteen birds, including the type of *dissors*, show the characters given for this form. A smaller series of six specimens from Santa Elena, Antioquia region, are not the same and in spite of the greater distance of the locality from western Ecuador, these birds are closer to *josephae* than is *dissors*. Since there is no name applicable to the birds in question, they may be known as follows.

Vireo gilvus disjunctus, new subspecies

TYPE from Santa Elena, Antioquia, Colombia; altitude 9000 feet. No. 134,056, American Museum of Natural History. Adult male collected November 18, 1914, by Leo Miller and Howarth Boyle; original No. 10,115.

DIAGNOSIS.—Similar above to the darker examples of *V. g. josephae* of western Ecuador but with the throat patch more restricted and less purely white. Differs from *V. g. maranoncus* of north-central and northwestern Perú by darker upper parts and (usually) paler under parts. Differs from *V. g. dissors* by darker upper parts and from *V. g. leucophrys* by darker and duller cap and darker and less brownish, more greenish, olive back.

RANGE.—At present known only from the type locality but occasional in "Bogotá" collections.

DESCRIPTION OF TYPE.—Whole top of head dark Chaetura Drab; back dark Olive; chin and upper part of throat whitish but lower throat pale yellowish; breast and belly Primrose Yellow; outer margins of wing and tail dark Yellowish Olive; pattern and minor details as in *V. g. maranoncus*. Wing, 71.5 mm.; tail, 49.5; exposed culmen, 11.25; culmen from base, 15.5; tarsus, 16.

REMARKS.—Females similar to the males in color but somewhat smaller. Wing, 63.75–66.5 (♂, 67–71.5); tail, 43–46 (♂, 46–49.5).

One "Bogotá" trade-skin appears to be referable here. The upper parts are a little more brownish than the Santa Elena birds but equally dark (darker than *leucophrys*)

and the top of the head is very dark. It differs from other "Bogotá" skins as the fresher Santa Elena birds do from the comparable birds from the Eastern Andes.

SPECIMENS EXAMINED

V. g. lartissimus.—

BOLIVIA:

Incachaca, 3 ♂, 1 ♀;

Locotal, 1 ♀.

PERÚ:

Santo Domingo, 1 ♂;

Idma, 1 ♂, 1 ♀;

San Miguel, 1 ♂, 1 ♀;

Santa Rita, 1 ♀;

Torontoy, 2 ♂.

V. g. leucophrys.—

PERÚ:

Utcuyacu, 3 ♂, 2 ♀;

La Lejía, 1 ♂;

Chinchao, 1 ♂¹.

ECTADOR:

Baeza, 1 ♀;

Sabanilla, 1 ♂, 1 ♀.

COLOMBIA:

"Bogotá," 8 (?);

Fusugasugá, 1 ♂, 1 ♀;

El Roble, 2 ♀;

near San Augustin, 1 ♂;

La Candela, 1 ♂, 1 ♀;

La Palma, 1 ♂;

Anolaima, 1 ♀;

San Cayetano, 1 (?);

Santa Marta, Las Nubes, 1 ♂, 2 (?);

El Libano, 3 ♂, 2 (?);

Valparaiso, 2 ♂.

VENEZUELA:

Mérida, Nevados, 2 ♂;

Escorial, 2 ♂;

Pinos, 1 ♂.

V. g. maranonicus.—

PERÚ:

Chaupe, 4 ♂ (incl. type), 2 ♀;

La Lejía, 1 ♂;

Palambilla, 1 ♂, 4 ♀, 1 (?);

Taulis, 2 ♂, 2 ♀;

Seques, 1 ♂, 1 ♀.

V. g. josepha.—

ECTADOR:

Coco, 2 ♂;

Pallatanga, 1 ♀;

Alamor, 4 ♂, 3 ♀;

Punta Santa Ana, 1 ♂;

San Bartolo, 1 ♂, 1 ♀;

Naranjo, 1 ♂;

Celica, 1 ♂;

Mindo, 1 ♂;

west side of Pichincha, 1 ♂;

Canzacota, 1 ♂.

V. g. dissors.—

COLOMBIA:

Cerro Munchique, 3 ♂ (incl. type), 1 ♀;

east of Palmira, 3 ♂, 1 ♀;

Primavera, 1 ♀;

San Antonio, 3 ♀;

Salento, 2 ♂;

El Eden, 1 ♀.

V. g. disjunctus.—

COLOMBIA:

Santa Elena, 2 ♂ (incl. type), 4 ♀;

"Bogotá," 1 (?).

V. g. mirandae.—

VENEZUELA:

Galipan, 2 ♂, 7 ♀;

Loma Redonda, 2 ♂;

Cumbre de Valencia, 1 ♂, 1 ♀;

El Limón, Puerto La Cruz, 1 ♂.

V. g. chiriquensis.—

PANAMÁ:

Chiriquí, Boquete, 9 ♂, 1 ♀, 1 (?);

Cerro Flores, 1 ♀;

Veraguas, Chitrá, 3 ♂, 2 ♀;

Cebaco Is., 1 ♂;

David, Sevilla Is., 1 ♀.

COSTA RICA:

Santa Maria de Dota, 2 ♂, 2 ♀;

Aguinanes, 2 ♂;

Agua Caliente, 1 ♂;

La Estrella, Cartago, 1 ♂, 1 ♀, 1 (?);

Barranca, 1 (?);

"Costa Rica," 2 (?).

V. g. amauronotus.—

MEXICO:

Vera Cruz, Jalapa, 4 ♂, 3 ♀, 1 (?).

Vireo altiloquus barbatulus (Cabanis)

Phyllomanes barbatulus CABANIS, 1855, Jour. für Orn., III, p. 467—Cuba; Berlin Mus.

Gadow (1883, Cat. Birds Brit. Mus., VIII, p. 294) list a single specimen from Chamicuros, collected by Hauxwell, as "*Vireo calidris* β *V. barbatula*." There is no other indication of the occurrence of the species in Perú. Bartlett's Chamicuros specimens (or specimen) had been assigned by Sclater and Salvin to "*olivaceus*" but probably belonged to *chiri* which they did not realize was found in Perú. Both *chiri* and *olivaceus* were known to Gadow, however, and it is not likely that a specimen of either would have been identified as *barbatulus*.

The question, of course, remains as to the correct subspecific assignment of Hauxwell's Chamicuros specimen. Gadow included *barbadensis* in what he considered as typical "*calidris*" [= *altiloquus*]. *Grandior* and *canescens* had not been distinguished in 1883 and in any case have not been reported as migrants. On the other hand I have a number of specimens of *altiloquus* and *barbatulus* from the Ama-

¹ Specimen in Field Museum of Natural History, Chicago.

zonian region though still a long way from Perú, and there is equal probability, so far as I can judge now, that either of these two forms might occur in Perú during the winter of the Northern Hemisphere. Accordingly I leave the Peruvian record as assigned by Gadow in *barbatulus*.

Without going into a detailed review of this species, I may state that a male from Muirapinimá and one from Igarapé Cacao Pereira, Rio Negro, Brazil, a male from Boca de Sina, Río Cunucunumá, Venezuela, and a bird without given sex from Suapure, Río Caura, a male from Masinga Vieja, Santa Marta, Colombia, and one from Bonda, Santa Marta, all agree best with a series of over eighty specimens of *altiloquus*, mostly from Jamaica and Hispaniola. A female from Igarapé Cacao Pereira and one from San Gabriel, Rio Negro, two males and a female from Faro, Rio Jamundá, a male from Buritaca, Santa Marta, Colombia, and a male, two females, and three birds without given sex from Bonda, Santa Marta, are closer to *barbatulus*, having the crown more clearly grayish, the dark line over the superciliaries less distinct, and the bill shorter than the average of *altiloquus*—in some of the specimens shorter than the minimum of that form. A specimen from Manaos, preserved in Field Museum of Natural History, has been assigned by Hellmayr to *altiloquus* but my notes on the specimen, made some years ago, indicate its probable identity with *barbatulus*, a conclusion strengthened by the Rio Negro and Faro specimens now at hand.

A single bird from Valencia, Trinidad, is quite certainly *barbadensis*. The dark upper surface, gray cap carried well over the hind neck, and the well-marked black stripe over the superciliaries place this specimen with a series of over thirty examples of that form. A male from Río Calovevora, Veragua, Panamá, is not so certainly assignable to this form but agrees better with it than with either *barbatulus* or *altiloquus*. I make a tentative assignment of it to *barbadensis* pending further material. There is a single record of *barbatulus* from Obaldia, Panamá, and one of *altiloquus* from the line of the Panamá Railroad!

I follow Hellmayr in adopting the specific name *altiloquus* for this group, considering *calidris*, *hispaniolensis*, and *virens* as unidentifiable; but, as discussed on a previous page, I accept Baird's action as first reviser in fixing the name *olivaceus* on the Red-eyed Vireo of North America for which Hellmayr adopted the name *virescens*.

Although there is considerable similarity between this group and the *olivaceus* group, there is enough distinction to warrant, in my belief, their specific separation.

SPECIMENS EXAMINED

V. a. altiloquus.—

ST. THOMAS: 8 ♂, 1 ♀, 2 (?).
SANTO DOMINGO: 27 ♂, 11 ♀, 1 (?).
NAVASSA: 3 ♂.
JAMAICA: 7 ♂, 3 ♀.
PUERTO RICO: 4 ♂, 4 ♀, 1 (?).
SOMBREIRO: 1 ♀ (type of *virginalis*), 1 (?)
(type of *atipennia*).

COLOMBIA:

Santa Marta, Bonda, 1 ♂;
Masinga Vieja, 1 ♂.

VENEZUELA:

Río Cunucunumá, Boca de Sina, 1 ♂;
Río Caura, Suapure, 1 (?).

BRAZIL:

Río Negro, Muirapinimá, 1 ♂;
Igarapé Cacao Pereira, 1 ♂.

V. a. barbatulus.—

CUBA: 22 ♂, 12 ♀, 4 (?).

BAHAMAS: 3 ♂.

ANDROS: 1 ♂, 1 ♀.

DRY TORTUGAS: 1 ♂.

COLOMBIA:

Santa Marta, Bonda, 1 ♂, 2 ♀, 4 (?);
Buritaca, 1 ♂;
Cúcuta.¹

BRAZIL:

Faro, 2 ♂, 1 ♀;
Rio Negro, San Gabriel, 1 ♀;
Igarapé Cacao Pereira, 1 ♀;
Manaos, 1 ♂².

V. a. barbadensis.—

DOMINICA: 5 ♂, 5 ♀, 1 (?).

ST. VINCENT: 2 ♂, 1 (?).

GUADELOUPE: 2 ♂, 2 ♀, 1 (?).

ANTIGUA: 1 ♂, 4 ♀, 1 (?).

SANTA LUCIA: 2 ♂, 2 ♀.

BARBUDA: 2 ♀.

SANTA CRUZ: 1 ♂.

TRINIDAD:

Valencia, 1 ♀.

PANAMÁ:

Río Calovevora, 1 ♂.

V. a. grandior.—

OLD PROVIDENCE: 1 ♂.

¹ Specimen in Cúcuta Museum.

² Specimen in Field Museum of Natural History, Chicago.

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A NEW CROCODYLIAN FROM THE LANCE FORMATION

BY CHARLES C. MOOK¹

In some vertebrate remains recently prepared for study at The American Museum of Natural History is a well-preserved crocodilian skull. This skull was collected by the American Museum Expedition of 1892 from the Lance Formation exposures on the Cheyenne River, Niobrara County, Wyoming.

The skull exhibits clearly typical eusuchian characters. In addition to these it also exhibits characters suggestive of true crocodiles of the genus *Crocodylus*, of *Diplocynodon*, of *Alligator*, and of *Caiman*. If all these characters are considered as directly indicative of relationships the form represented might well be considered as ancestral to the above genera, which are now assigned to two distinct families of crocodilians. Some of the characters noted are undoubtedly secondary and resemble those of some of the living genera by evolutionary convergence rather than by close affinities.

Eusuchian crocodiles from the Lance are rather rare and the clear-cut characters of this skull definitely indicate a new genus and species. The resemblance of its characters to *Diplocynodon* of the Eocene of Europe appears greater and more significant than the resemblances to other known genera and the genus is therefore called *Prodiplocynodon*. The specific name *langi* is designated in honor of Mr. Charles Lang, of the Department of Vertebrate Paleontology, of The American Museum of Natural History, who has prepared and mounted many specimens of fossil vertebrates, including crocodiles, at the American Museum and elsewhere.

PRODIPLOCYNODON, NEW GENUS

TYPE.—*Prodiplocynodon langi*, new species.

DIAGNOSTIC CHARACTERS.—Typical eusuchian

characters, skull short, broad, and triangular; fourth and fifth maxillary alveoli of equal size and larger than other alveoli; teeth stout; interorbital plate somewhat above level of base of snout, and separated from it by a bony wall much as in the caimans.

Prodiplocynodon langi, new species

TYPE.—Skull, Amer. Mus. No. 108. Collected by Amer. Mus. Exp. of 1892.

TYPE LOCALITY AND LEVEL.—Lance Formation, Cheyenne River, Niobrara County, Wyoming.

DIAGNOSTIC CHARACTERS.—Characters enumerated for the genus; five alveoli in each premaxillary, with none of them diminutive in size or crowded close to another; supratemporal fenestrae considerably broader than long; distal end of quadrates high in position; external narial aperture very large; supraoccipital forming part of cranial table; orbits large, and distinctly acuminate anteriorly.

DESCRIPTION OF CHARACTERS

PRESERVATION.—The skull is unusually complete except for the region of the left quadrate, quadratojugal, jugal, and postorbital, these elements being largely missing. The anterior tips of the nasals are also missing. There is a slight lateral compression toward the right on the superior surface so that a plane passing through the center of the Eustachian pit would dip definitely toward the left. Seven teeth are more or less completely preserved on the left side and a few incomplete teeth are present on the right side. The sutures in some cases are clearly marked but are often indistinguishable or obscured by cracks.

GENERAL FORM.—The skull is relatively short and broad at the posterior end and triangular in outline. The tip of the snout, however, is broadly rounded and not sharp. The snout is distinctly constricted at the premaxillary-maxillary contact but the constriction is not deep. There is a riding surface for the inner side of the large mandibular tooth, this occlusion being intermediate in character between the condition in *Crocodylus* and that in *Alligator*. The snout is low in vertical direction and the posterior region is moderately low. The distal ends of the quadrates are high in position. The surface pitting is moderately rough, but is not distinctive. The lateral festooning of the jaw

¹ Contributions to the Osteology, Affinities and Distribution of the Crocodilia, No. 34.

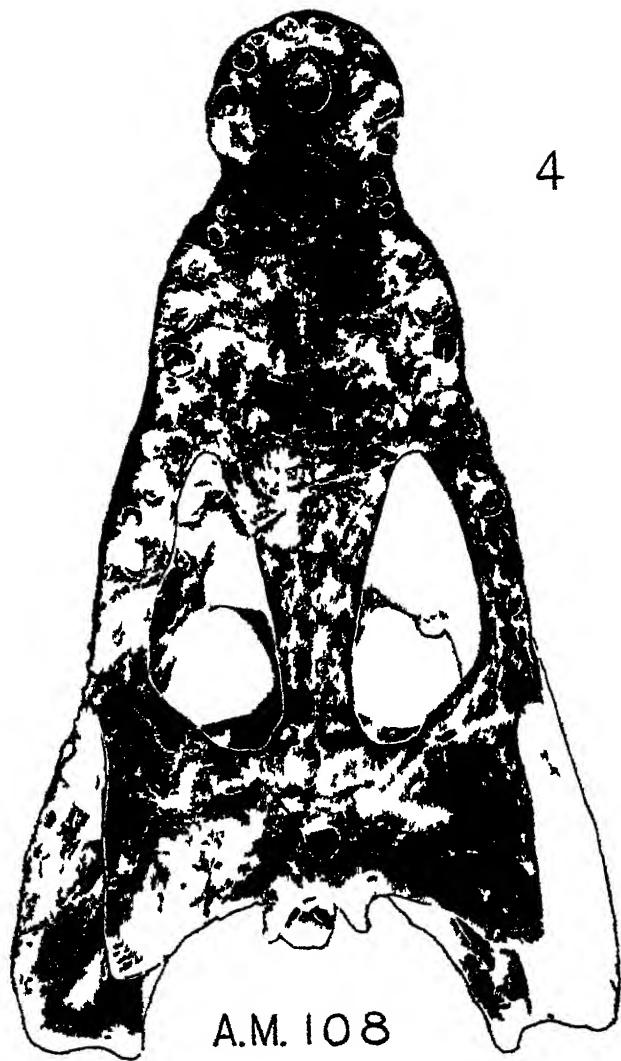


Fig 1 *Prodyoplognodon langi* new species. Type skull Amer Mus No 108, interior view one-fourth natural size

is moderate. The median excavation at the base of the snout separating the snout from the interorbital plate is moderately sharp instead of being broadly rounded as in the camans.

OPENINGS OF THE SKULL.—The external nasal aperture is relatively large. It extends backward almost to the level of the premaxillary constriction. Its posterior border is at the

same level as the anterior end of the fifth premaxillary tooth. It is broadly rounded anteriorly and at points about one-third of the total length posterior to the extreme anterior margin the lateral borders become straight and converge decidedly until they come in contact with the anterior extensions of the nasal bones into the aperture.

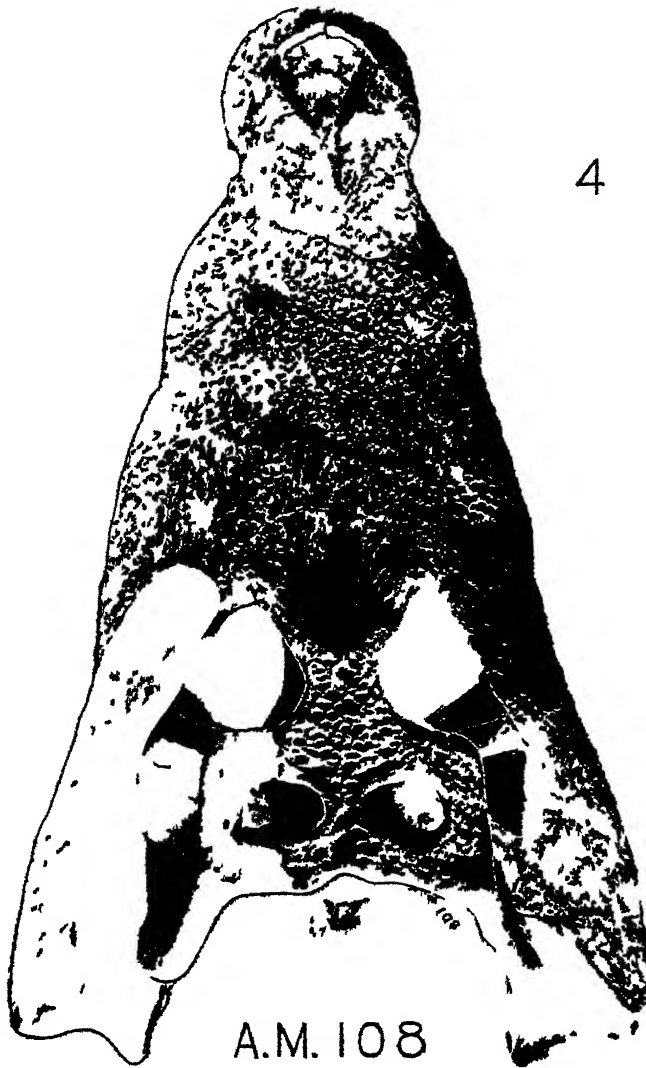


Fig 2 *Prodiplacynodon langi* new species. Type skull Amer Mus No 108 superior view one-fourth natural size

The orbits are large and are subtriangular in outline. They are roundly pointed but not acute anteriorly. The lateral borders are nearly straight the external border of each for its entire length and the internal border for about two-thirds of its length. Most of the posterior border is straight and extends inward and slightly backward from the fairly sharp postero-

external corner to the rounded postero-internal corner. The interorbital plate is moderately broad and is flat. The two orbits face almost directly upward with very little forward or lateral components of position. This appears to be due only slightly to compression of the specimen.

The supratemporal fenestrae are represented

by the right unit only, the entire outer border of the left side being missing.

The right fenestra is very irregular in shape. Its antero-posterior diameter is considerably less than the transverse. Its inner half is shorter antero-posteriorly than its outer half. The inter-fenestral plate is moderately narrow and is only slightly uprolled at the edges.

The lateral temporal fenestrae are not distinctive.

The premaxillary foramen is unusually large. It is moderately broad for its length. It is acute anteriorly and it is broadly rounded posteriorly, its posterior half being semicircular.

The palatine fenestrae are very large and distinctive in outline. Their inner margins are only slightly curved. Their outer margins are somewhat irregular. Their axes of greatest breadth lie far back near their posterior ends, entirely posterior to the level of the last teeth.

The internal narial aperture is back near the posterior border of the pterygoids but not so far back as in living crocodiles. Its margins are not completely preserved.

BONES OF THE SKULL ON SUPERIOR ASPECT.—The sutures on the snout are not clearly visible but in some cases they can be made out in part at least. The premaxillaries apparently do not extend very far back. The maxillaries do not show special characters. The nasals extend definitely into the external narial aperture as a conspicuous wedge. The outlines of the lacrimals and prefrontals are not clearly discernible, but there is no doubt but that they follow the crocodilid rather than the alligatorid relations. The characters of the frontal are not distinctive except for the median pit noted above. The postorbitals, squamosals, and parietal exhibit no striking characters.

The supraoccipital occupies a small area on the cranial table. This area is comparatively broad laterally and very short antero-posteriorly, making this part of the bone distinctive in outline.

BONES OF THE SKULL ON PALATAL ASPECT.—The premaxillary region is broad and short. There are five alveoli in each premaxillary. They are spaced almost equally apart. The first and second are of moderate size, the third is larger, the fourth is considerably larger, and the fifth is about equal to the first in size. There is a large pit which received the first mandibular tooth, which must have been very large, posterior to the first two premaxillary teeth and antero-external to the premaxillary foramen. This pit overlaps the foramen considerably. In the living alligators and crocodiles the corresponding pit is decidedly anterior to the foramen. Another pit, small in size, is located internal to the space between the third and fourth alveoli, and another small pit is internal to the fourth alveolus.

The premaxillo-maxillary suture extends back-

ward only to the level of the second maxillary teeth.

The maxillary portion of the palate is comparatively short. The maxillo-palatine suture is obscure. The first maxillary alveolus is small; the second and third are progressively larger, the fourth is much larger than the third, being approximately equal in size to the fifth. Nine moderately large, subequal alveoli are situated posterior to the fifth and one small alveolus is posterior to these.



Fig. 3. *Prodiplotocynodon langi*, new species. Type, skull, Amer. Mus. No. 108, lateral view, right side.

The palatines apparently do not extend forward very far beyond the level of the anterior ends of the palatine fenestrae. Near these ends they are very broad. Near the posterior ends of the fenestrae they are narrow. The palatopterygoid suture is distinctly anterior to these posterior ends; the pterygoids consequently participate in the inner as well as the posterior borders of the fenestrae. The posterior processes of the pterygoids, near the mid-line, are unusually large and prominent.

The last premaxillary tooth of the left side is well preserved. It is short and stout, but is also sharp, both on its tip and on its anterior and posterior edges. It is faintly striated. The third left maxillary tooth is incompletely preserved, the sixth left tooth is completely and the

Length, tip of snout to occipital condyle.	496
Length, tip of snout to base of snout....	312
Length, tip of snout to notch.....	80
Length, tooth row, right side.....	352e
Length, tooth row, left side....	348
Length, external narial aperture	54
Length, right orbit	71
Length, left orbit.	68
Length, right supratemporal fenestra....	33
Length, premaxillary foramen.....	30
Length, right palatine fenestra.....	158
Length, left palatine fenestra.....	155
Breadth, premaxillaries, maximum	107
Breadth, premaxillaries at constriction..	89
Breadth, snout at 5th maxillary teeth ...	165
Breadth, snout at base.....	238



Fig. 4. *Prodiplocynodon langi*, new species. Type, skull, Amer. Mus. No. 108, posterior view, one-fourth natural size.

sixth right incompletely preserved. The ninth and tenth left teeth are incompletely preserved. The tenth left tooth shows the tips appearing in the matrix in the alveolus and the tenth right tooth is well worn. The eleventh and twelfth left maxillary teeth are all well preserved. All of these teeth are similar in character, being stout, moderately sharp, and short. They show less variation according to location in the jaw than do most crocodilian teeth. They are somewhat similar to the teeth of *Goniopholis* except that the striations are weaker.

MEASUREMENTS

Length, tip of snout to supraoccipital border.....	mm. 466
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Breadth, external narial aperture	45
Breadth, right orbit, maximum....	61
Breadth, left orbit, maximum.....	69
Breadth, interorbital plate.....	38
Breadth, right supratemporal fenestra. .	47
Breadth, interfenestral plate.....	39
Breadth, cranial table.....	160e
Breadth, premaxillary foramen.....	23
Breadth, right palatine fenestra....	71
Breadth, left palatine fenestra.....	73
Breadth, between palatine fenestra, minimum.....	39
Breadth, pterygoids at tips.....	232
Breadth, between articular processes of quadrates.....	190
Breadth, across quadrates, estimated....	310

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THE LAND MOLLUSCA OF THE SOLOMON ISLANDS (SUCCINEIDAE, BULIMULIDAE AND PARTULIDAE)

BY WILLIAM J. CLENCH¹

INTRODUCTION

This report is based in greater part upon the land mollusks collected by the members of the Whitney South Sea Expedition during their stay in the Solomon Islands. Most of the material obtained was collected by W. J. Coultas, W. J. Eyerdam and Dr. E. Mayr.

It has been considered best to make this paper more inclusive than a mere list of the species obtained, as most of the papers so far published for this island group have dealt only with the descriptions of the new

species rather than a complete summary of the molluscan fauna of the individual islands and the problem of their geographical distribution.

In addition to the Whitney collections the mollusks collected by W. M. Mann² have been restudied and the results incorporated in this report.

This portion of the report deals with the Succineidae, Bulimulidae and the Partulidae inhabiting these islands.

ACKNOWLEDGMENTS

I am under deep obligation to Dr. R. W. Miner of The American Museum of Natural History, for the privilege and pleasure of working up this collection, and to W. J. Eyerdam and E. Mayr of the Whitney Expedition for much additional information about the islands and the localities where the material was obtained.

To Dr. E. Paravicini of Basel, Switzerland, I am grateful for a large series of land and freshwater mollusks recently collected by him in the Solomon Islands.

To Dr. C. M. Cooke of the Bernice P. Bishop Museum for a loan of the Solomon Island land mollusks obtained mainly by the Crocker Expedition.

To Dr. W. M. Mann I am indebted for a map explaining his route and collecting places in the Solomons as well as much additional information relative to the shells he collected.

To Mr. F. P. Orchard my thanks are due for his careful and painstaking work upon the photographs.

HISTORY

The first scientific expedition to investigate the Solomon Islands was that of Dumont D'Urville which was made in the western Pacific during the years 1837 to 1840. The "Astrolabe" and "Zelee" were the two ships that figured in this voyage; the former earlier became famous through the pioneer work of Quoy and Gaimard

while in Australasian waters. Though D'Urville sailed the entire length of the Solomon archipelago, collections were made only at the southeastern extremity of the island of Ysabel. The mollusks collected were named and figured by the naturalists, Hombron and Jacquinot, who accompanied the expedition; the formal

¹ Museum of Comparative Zoölogy, Cambridge, Massachusetts.

² W. F. Clapp (1923) published upon the shells obtained by W. M. Mann. He did not include, however, the land operculates.

descriptions were written by L. Rousseau, assistant at that time in the Jardin des Plantes. The original locality, "Isles de Salomon," which is given for all of their new species described from these islands refers actually to the single island named above. According to Sherborn both text and atlas of plates were published in 1854.

During 1865, J. L. Brenchley, accompanied by John Brazier, paid a short visit to the Solomons. This expedition was that of the "Curaçoa," made by the British to establish new and reestablish old claims of possession in the Solomons and other island groups in the Pacific. Only a few days were spent in the Islands from August 27 to September 10 of that year. Several marine and a single land species (*Helicina julii*) were described as new by W. Baird from the material obtained on this trip. Brazier later made a second trip to the Solomons and, in addition to the material of his own collecting, received much material from traders and missionaries. His new species were described mainly in the Proceedings of the Zoological Society of London, both by him and several associates who had access to his large collection. The "Curaçoa" visited Ulakua [Ulawa]; Uji [Ugi]; San Christoval; Guadalcanar; Florida and Ysabel.

We owe to Dr. H. B. Guppy the most comprehensive account of the Solomon Islands that has thus far appeared. During the years from 1881 to 1884, he was surgeon on H.M.S. "Lark," at that time engaged in hydrographic work in the Islands. Besides his many duties as ship's doctor, he acted as naturalist of the voyage and his time away from the ship was devoted to the exploration and study of the geology, flora and fauna of the Islands. Land and freshwater shells formed an important part of his studies, and the large collection he made was studied and published upon by E. A. Smith in 1885. His own publication which appeared two years later in a two-volume report contains a complete list of the many species he obtained with their localities and notes.

In 1916, Dr. W. M. Mann, now Director of the Zoological Park, Washington, D. C., made a stay of several months in the Solo-

mon Islands. Though mainly interested in insects, he collected a superb series of mollusks, now in the Museum of Comparative Zoölogy, and this material formed a basis for the paper by W. F. Clapp on the land pulmonates of the archipelago. The new species collected by Dr. Mann were described and a list of most of the known land pulmonates recorded for this region was included.

The Whitney South Sea Expedition was in the Solomons during the latter half of 1929 and the early part of 1930. Though mainly engaged in collecting birds, Mr. W. J. Eyerdam and Dr. E. Mayr collected a very large series of shells. This collection is very carefully localized and includes material from new regions on the large islands and from many of the smaller islands not previously explored.

A small series of land mollusks was collected by the Crocker Expedition in the Solomons during 1934. The island of Gizo, off the north coast of New Georgia was explored and a few shells obtained. This is the first time that any specific records are available for this small island. The few other localities from which shells were obtained were not new, however, the records are included in this report.

The Whitney and Mann collections have formed the basis for the present study. A large number of shells from the Solomon Islands, in the collection of the Museum of Comparative Zoölogy, received many years ago from Brazier, Cox, Pease and others, have made possible a much better understanding of the land mollusks of this group. There is still, however, much more to be accomplished in this area. All of the above named expeditions were made for purposes other than the collecting of mollusks, and such that were obtained were only incidental to other interests. Many of the early collections were poorly localized, and certain of the old records are based on material now known to occur outside of the Solomons. Many of the Cumingian species described by Pfeiffer are in this category.

In addition to the material derived from the above sources, many other lots have been studied that do not figure in the pres-

ent distributional records. Their history is unknown, and the locality unknown or simply labeled, "Solomon Islands." Many lots of this sort are in the Pease collection (now in the M.C.Z.) and were probably originally received from Cox, Coxen and Beddome, Australian collectors who supplied a host of shells from the Australasian region to museums and private collectors two generations ago.

As stated above, there is yet a vast field remaining for the collector in this group of islands. All of the larger and most of the smaller islands are still very imperfectly known. This is especially true for the many small islands associated with the island of New Georgia. Bougainville, the northernmost island of the group, has received but little attention and mollusks from this region are much to be desired. Only a few are known and several of these appear to be quite sharply differentiated from those of the other islands to the south.

The interior mountainous regions of all the islands are practically unstudied. Dr. Mann crossed northern Malaita and eastern San Christoval; Eyerdam, with his associates, penetrated the islands of Malaita and San Christoval in a few places to the highland areas within. So far as I have been able to ascertain, no mollusks have ever been obtained from the interior of the remaining larger islands. Highland species are of the greatest importance in distributional studies, as those peculiar to the higher altitudes are less likely to be distributed mechanically between different islands than those occupying the coastal areas, and consequently lend greater strength to arguments favoring former land connections.

However, it is fully appreciated that there are many difficulties to overcome in the exploration of these islands. Hostility of the natives, lack of trails and much inaccessible coastline make collecting hazardous and in many places quite impossible.

COLLECTING STATIONS OF W. M. MANN

FLORIDA ISLAND:

Tulagi (S. Lat. $9^{\circ} 5' 30''$; E. Long. $160^{\circ} 10'$).

GUADALCANAR ISLAND:

Rere (S. Lat. $9^{\circ} 25'$; E. Long. $160^{\circ} 12'$; position approximate).

MALAITA ISLAND:

Auki (S. Lat. $8^{\circ} 52'$; E. Long. $160^{\circ} 48' 30''$).

Fourati (S. Lat. $8^{\circ} 35'$; E. Long. $160^{\circ} 50'$; position approximate).

Atta [Ata] (S. Lat. $8^{\circ} 31'$; E. Long. $160^{\circ} 55'$).

NEW GEORGIA ISLAND:

Rubiana (S. Lat. $8^{\circ} 20'$; E. Long. $157^{\circ} 17'$).

Labeti, Rubiana Lagoon (S. Lat. $8^{\circ} 16'$; $157^{\circ} 25'$; position approximate).

Kepi, Rubiana Lagoon (S. Lat. $8^{\circ} 16'$; $157^{\circ} 25'$; position approximate).

Rendova (Isl.) (S. Lat. $8^{\circ} 25'$; E. Long. $157^{\circ} 21'$).

Marovo Lagoon [Maravo] (S. Lat. $8^{\circ} 30'$; E. Long. 158°).

RUSSELL ISLAND:

(S. Lat. $9^{\circ} 3'$; E. Long. $159^{\circ} 5'$).

SAN CRISTOVAL ISLAND:

Bio Isl. (S. Lat. $10^{\circ} 10'$; E. Long. $161^{\circ} 41'$).

Pamua (S. Lat. $9^{\circ} 24'$; E. Long. $161^{\circ} 44'$; position approximate).

Santa Anna Isl. (S. Lat. $10^{\circ} 50'$; E. Long. $162^{\circ} 28'$).

Star Harbor [Bulimatarivo] (S. Lat. $10^{\circ} 49'$; E. Long. $162^{\circ} 16'$).

Three Sister Isls. (S. Lat. $10^{\circ} 11'$; E. Long. $161^{\circ} 56'$; center island).

Ugi Isl. (S. Lat. $10^{\circ} 15'$; E. Long. $161^{\circ} 44'$).

Wai'ai [Wai-ai] (S. Lat. $10^{\circ} 22'$; E. Long. $161^{\circ} 39' 30''$).

Wainoni Bay (S. Lat. $10^{\circ} 30'$; E. Long. $162^{\circ} 2'$).

YSABEL ISLAND:

Fulakora (S. Lat. $8^{\circ} 21'$; E. Long. $159^{\circ} 51'$).

COLLECTING STATIONS OF THE WHITNEY SOUTH SEA EXPEDITION

(Solomon Islands only)

BOUGAINVILLE ISLAND:

Buin (S. Lat. $6^{\circ} 49' 30''$; E. Long. $155^{\circ} 45'$).

Kieta (S. Lat. $6^{\circ} 13'$; E. Long. $155^{\circ} 40'$).

BELLONA ISLAND:

(S. Lat. $11^{\circ} 25'$; E. Long. $159^{\circ} 45'$).

CHOISEUL ISLAND:

Bambatini [Sasamanga] (S. Lat. $7^{\circ} 4' 30''$; E. Long. $156^{\circ} 46'$).

Choiseul Bay (S. Lat. $6^{\circ} 41'$; E. Long. $156^{\circ} 26'$).

Luti (S. Lat. $7^{\circ} 15'$; E. Long. 157° ; position approximate).

Papera [Poro-poro] (S. Lat. $6^{\circ} 41'$; E. Long. $156^{\circ} 26'$; position approximate).

Sumbi (S. Lat. $7^{\circ} 15'$; E. Long. 157° ; position approximate).

Taoro (S. Lat. 7° 24'; E. Long. 157° 35'; position approximate).

Wuulata River (S. Lat. 7° 15'; E. Long. 157°; position approximate).

FLORIDA ISLAND:

Tulagi (S. Lat. 9° 5' 30"; E. Long. 160° 10').

Olevuga Isl. (S. Lat. 9°; E. Long. 160° 5' 30').

GOWER ISLAND:

(S. Lat. 7° 54'; E. Long. 160° 37').

GUADALCANAR ISLAND:

Berendi (S. Lat. 9° 24' 30"; E. Long. 160° 17').

MALAITA ISLAND:

Auki (S. Lat. 8° 52'; E. Long. 160° 48' 30").

Aurola [Arorla] (S. Lat. 8° 58'; E. Long. 161° 5'; position approximate).

Kwarambara (S. Lat. 8° 57'; E. Long. 161° 6'; position approximate).

Maramasiki (S. Lat. 8° 30'; E. Long. 161° 30'; position approximate).

Su'u (S. Lat. 9° 13'; E. Long. 161° 2'; position approximate).

Ulimburi (S. Lat. 8° 57'; E. Long. 161° 6').

RENNEL ISLAND:

(S. Lat. 11° 35'; E. Long. 160° 20').

SAN CRISTOVAL:

Kira Kira

SHORTLAND ISLAND:

Faisi (S. Lat. 7° 4'; E. Long. 155° 53').

ULAWA ISLAND:

(S. Lat. 9° 46'; E. Long. 161° 58').

All members of the scientific staff of the Whitney Expedition aided in collecting the mollusks in the Solomons.

The latitude and longitude of the localities for both the Mann and Whitney collections were obtained from U. S. Hydrographic charts: 2896; 2902; 2907; 2911; 2912; 2916; 2920.

SUCCINEIDAE

SUCCINEA DRAPARNAUD, 1801

Tableau des Mollusques de la France, p. 55. Paris.

GENOTYPE.—*Helix putris* Linné.

This genus is practically world wide in distribution, not exceeded by any other genus of land shells in its extensive range. There are but few differential characters to distinguish the many species, and a vast amount of material will be necessary for study before we are at all certain that many of the names now in use are really valid. They are easily transported by birds, as specifically noted by Ramsden (1913, p. 71) for *Succinea riisi* (Cuba), and very probably other species have been similarly distributed in this manner.

Succinea simplex Pfeiffer

Figure 12

Succinea simplex PFEIFFER, 1854 [1855], Proc. Zool. Soc. London, p. 123 (Solomon Islands).—E. A. SMITH, 1885, Proc. Zool. Soc. London, p. 595.—H. B. GUPPY, 1887, The Solomon Islands and Their Natives, London, I, p. 345.—W. F. CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 418.

REMARKS.—A small, light amber-colored species which probably occurs throughout the entire archipelago. It seems to be closely related to *S. montrouzieri* Crosse, from New Caledonia, and it is quite possible that the two are the same species. I have no material of the latter to make comparisons.

RECORDS.—Bio: (Clapp). Bellona: (Whitney). New Georgia: Labeti, Rubiana Lagoon (Clapp). Rennell: (Whitney). Santa Anna: (Eyerdam). Shortland: (Smith); Faisi (Whitney). Treasury: (Smith). Ugi: (Clapp).

BULIMULIDAE

PLACOSTYLUS BECK

1837, Index Molluscorum, p. 57.¹

GENOTYPE.—*Bulimus fibratus* Martyn.

A genus of mainly large land snails of the southwestern Pacific islands. Its range extends from the northern portion of North Island, New Zealand, to the island of Bougainville in the Solomons and includes Lord Howe Island, New Caledonia, New Hebrides, the Loyalty and the Fiji islands.

They are found on the ground as well as on bushes and trees, especially in cleared areas about villages. Certain subgenera such as *Aspastus* appear to be entirely arboreal. Several of the New Caledonian species are very large and are exceeded in size only, among the land snails, by members of the genera *Achatina* (African) and *Strophocheilus* (South American). In New Caledonia they form an important item of food (Cockerell, 1929, p. 73). Though apparently not eaten by the natives in the Solomons, they are used to some extent for decorative purposes (Brenchly, 1873, p. 251).

Eyerdam reports in his field notes that dogs feed upon them to a considerable extent. Very probably the ground species

¹ See Pilsbry, 1900, p. 19.

are eaten, as well, by pigs. No other enemies have been recorded as far as I am aware, although, as stated above, they are occasionally used by the natives for decorative purposes. Guppy (1887, p. 338) noted that the natives gathered (*P. cleryi*) [dead shells?] and dropped them into piles along the forest path, though he was never able to learn the reason for this peculiar practice.

SUBGENUS PLACOSTYLUS

A single species, *P. gizoensis*, of this subgenus occurs in the Solomons and it is the only member known to occur north of New Caledonia. All other Solomon Island subgenera are peculiar to the archipelago, though *Proaspastus* and *Eumecostylus* show a strong relationship to *Callistocharis* and *Euplastostylus*, of the Fiji Islands.

Placostylus (*Placostylus*) *gizoensis*, new species

Figure 10

DESCRIPTION.—Shell medium in size, solid, somewhat attenuated and imperforate. Color: earlier whorls pale straw or very light yellowish brown, later whorls covered by a deep brown periostracum which shows some spiral bars of deeper color in transmitted light. Lip materially thickened, white along the outer edge, red within. The entire inner portion of the aperture is deep red, both outer and inner sides. Whorls 6, slightly convex. Aperture subovate. Parietal wall calloused heavily. No parietal tooth. Columella thick, slightly oblique and ridged on its inner face. Columellar callous extending over the umbilical area leaving only a minute chink. Sculpture: first 2 1/2 (embryonic) whorls pitted, following whorls irregularly ridged with growth lines. Spire produced at 40°. Aperture cast at an angle of 16° from the vertical.

LENGTH	WIDTH	APERTURE	
54.5	25.0	23 0 × 9.5 mm.	Holotype
56.5	25.5	24.5 × 11.5	Paratype

HOLOTYPE.—B. P. Bishop Museum, No. 106216, Gizo Island [New Georgia Group], Solomon Islands, A. Seale, collector. Paratype, M.C.Z. 106357, with the same date.

REMARKS.—The species shows a very striking resemblance to *P. bivariatus* of Lord Howe Island. Differences between the two forms are trivial and it is with some hesitation that this form is presented here as a new species. As A. Seale also

collected *P. strangei* Pfeiffer on Gizo, a species of the New Georgia group of islands, the question of an error in the assignment of locality is materially reduced.

The two specimens of this new species do differ in being heavier, and more solid, the periostracum a deeper brown rather than a reddish brown as is to be found in *P. bivariatus*, and the earlier whorls are a pale straw-brown rather than reddish brown as in this latter species.

It would appear that *P. gizoensis* is a remnant of *Placostylus*, s.s., in the Solomon Islands, as all other species belong to other and probably later evolved subgenera. Further exploration may bring to light other members in this subgenus.

Its relationships with the Lord Howe Island species may be purely a case of parallelism, or a persistence of form without change from the early stock.

SUBGENUS PLACOCHARIS PILSBRY

1900, Man. of Conch., (2) XIII, p. 79.

SUBGENOTYPE.—*Bulimus macgillivrayi* PFEIFFER.

Shells smooth or spirally malleated, usually uniformly dark colored, sometimes with axial bars of a darker color superimposed over the ground pigmentation. Lip generally white, occasionally red or tinged with brown. Axis not generally widely spiral.

Species of this subgenus are usually terrestrial, occasionally found climbing on bushes.

Placostylus (*Placocharis*) *founaki* ("Hombron and Jacquinot" Rousseau)

Bulimus founaki "Hombron and Jacquinot" ROUSSEAU, 1854, Voy. au Pole Sud, V, p. 32, Pl. VIII, figs. 13-15 (Iles Solomon [south end of Ysabel]).

Bulimus stutchburyi var. *B. CROSSE*, 1864, Jour. de Conch., XII, p. 142 [based on all figures of *B. founaki*].

Bulimus hombroni CROSSE, 1871, Jour. de Conch., XIX, p. 178 (Ile Isabelle [Ysabel]).—BRAZIER, 1889, Jour. de Conch., VI, p. 80.

Bulimus (*Placostylus*) *founaki*, SMITH, 1885, Proc. Zool. Soc. London, p. 595.—GUPPY, 1887, The Solomon Islands and Their Natives, London, I, p. 345.

Placostylus founaki, KOBELT, 1901, Conchy.-Cab., I, pt. 13A, pp. 33 and 76, Pl. VIII, figs. 2-3, Pl. XVIII, figs. 2-6 [Kobelt first considered this species under *P. macfarlandi*, p. 33, Pl. VIII,

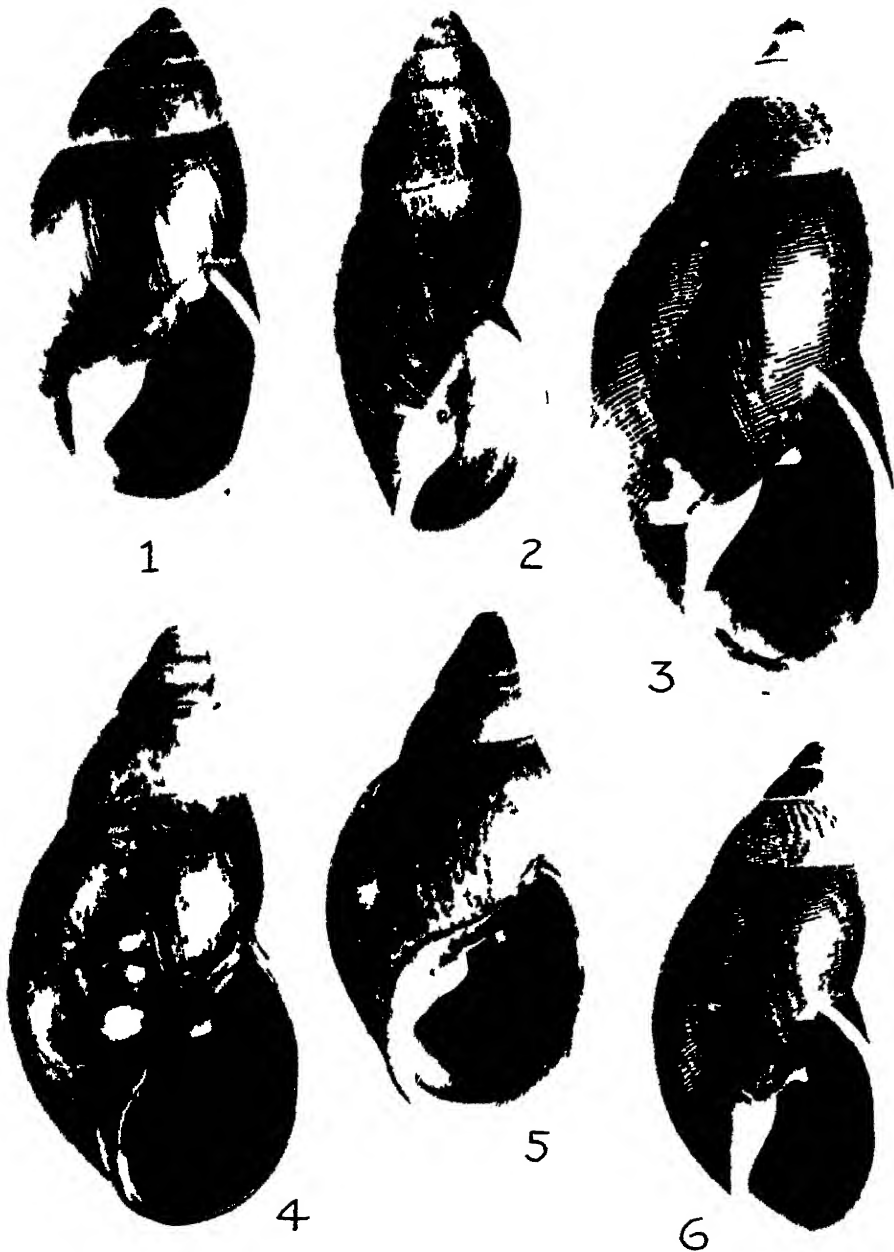


Fig. 1. *Placostylus paravicinianus* Rensch.
 Fig. 2. *Placostylus fraterculus* Rensch.
 Fig. 3. *Placostylus kirakiraensis* Rensch.
 Fig. 4. *Placostylus malaitensis* Clench Holotype
 Fig. 5. *Placostylus acutus* Clench Holotype
 Fig. 6. *Placostylus galleogor* Clench Holotype
 All figures natural size.

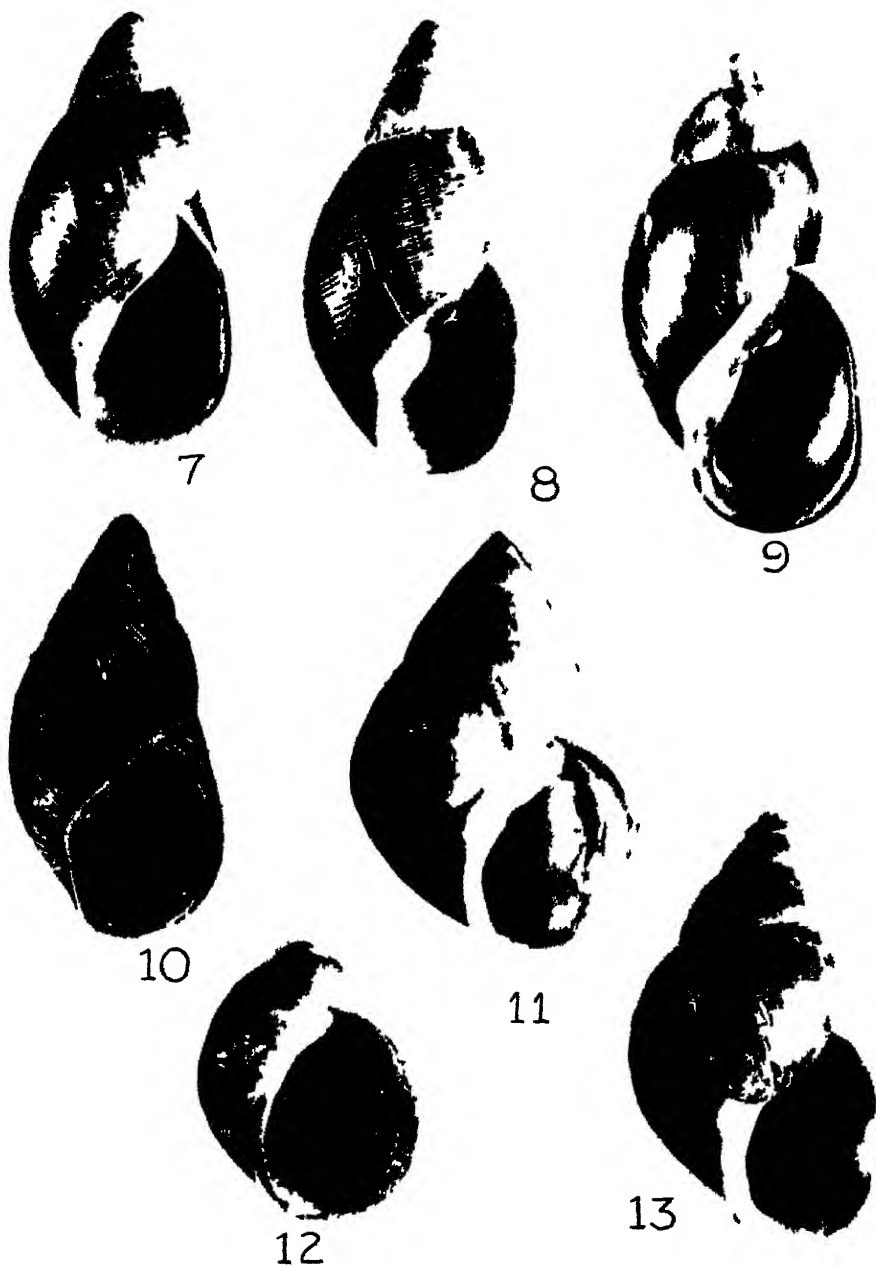


Fig. 7. *Placostylus almiranta* Clench. Holotype.

Fig. 8. *Placostylus vicinus* B. Rensch. Paratype.

Fig. 9. *Placostylus ophu* Clench. Holotype.

Fig. 10. *Placostylus griseus* Clench. Holotype.

Figures 7 to 10 natural size

Fig. 11. *Partula incurva* Hartman. Topotype. $\times 4$

Fig. 12. *Succinea simplex* Pfeiffer. Rennell Id. $\times 4$

Fig. 13. *Partula campstoni* Clench. Paratype. $\times 2$

figs. 2-3, and on p. 76 refers the figures to *P. founaki*].

Placostylus (Placocharis) founaki, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 79, Pl. XXXIV, figs. 10-14.—CLAPP, 1923, Bull. Mus. Comp. Zoöl., LXV, p. 407.

REMARKS.—This species is quite variable both in color and in size and, according to Eyerdam, it is to be found both on the ground and on bushes.

A single specimen found by Eyerdam on Bougainville deserves a special note. Although it is a dead shell, it has the shape and appearance of this species and agrees both in shape and in size with specimens from Choiseul. In his field notes, Eyerdam mentioned that this specimen was the only *Placostylus* found on Bougainville at the several localities at which he made collections. This record marks the most northwestern limit of this genus.

There are as yet a few species in this genus that have not been definitely assigned to any specific locality, but their general characters would place them with species on the islands in the southeastern portion of the archipelago.

RECORDS.—Bougainville: Kieta (Whitney). Choiseul: Bambatani; Choiseul Bay; Luti; Taoro (Whitney). Faro: (Pilsbry; Smith). Treasury: (Brazier). Ysabel: (Brazier; Crosse; Guppy; Pilsbry); Fulakora (Clapp).

***Placostylus founaki paletuvianus*
(Gassies)**

Bulimus paletuvianus GASSIES, 1859, Jour. de Conch., VII, p. 370 (L'île Art, Nouvelle-Calédonie).—GASSIES, 1863, Faune Conchy. de la Nouvelle-Calédonie, Paris, I, p. 48, Pl. II, fig. 2.—CROSSE, 1871, Jour. de Conch., XIX, p. 177.

Bulimus rhizophorae GASSIES, 1871, Faune Conchy. de la Nouvelle-Calédonie, II, p. 91 [*B. rhizophorae* in the index and *B. rhizophorae* in his Faune Conchy., III, p. 100].

Bulimus rhizophorae GASSIES, 1878, Jour. de Conch., XXVI, p. 337.

Placostylus (Placocharis) founaki paletuvianus, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 80, Pl. XXXIV, figs. 18-19.—CLAPP, 1923, Bull. Mus. Comp. Zoöl., LXV, p. 407.

REMARKS.—I have not seen this variety which differs only in the lack of strong color blotches. It may, however, form a local race, and is probably localized on some specific island in the Solomon group. Gassies was in error in citing this form as

coming from New Caledonia as was first noted by Crosse.

There are probably other races of subspecific value in this species that can be segregated eventually from the typical form. At present, however, the lack of a large series obtained from different localities makes it inadvisable to add any more names.

***Placostylus (Placocharis) manni* Clapp**

Placostylus (Placocharis) manni CLAPP, 1923, Bull. Mus. Comp. Zoöl., LXV, p. 411, Pl. V, figs. 1-2 (Auki, Malaita).

REMARKS.—The shells of this species are larger than any other in the subgenus *Placocharis*, and much darker in coloration. In addition to the characters mentioned by Clapp in the original description, the shells are materially depressed dorso-ventrally. This character is found in *P. founaki* to a limited extent. The following measurements are based on a portion of the type series:

LENGTH	LESSER WIDTH	GREATER WIDTH	
85.0	30.5	41.0 mm.	Holotype
83.5	30.5	39.0	Paratype
84.0	29.0	39.0	"
83.5	29.0	37.0	"
80.0	29.0	37.5	"

RECORDS.—Malaita: (C. M. Cooke); Auki (Clapp).

***Placostylus (Placocharis) guppyi* Smith**

Placostylus guppyi SMITH, 1891, Proc. Zool. Soc. London, p. 489, Pl. XL, fig. 6 (Solomon Islands).

Placostylus (Placocharis) guppyi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 82, Pl. XXXV, fig. 26.—CLAPP, 1923, Bull. Mus. Comp. Zoöl., LXV, p. 407.

REMARKS.—A single specimen of this species has been received from Dr. Paravicini. It appears to be related to *P. macfarlandi* Brazier, differing, however, in being darker in coloration, possessing a more acute spire, having the inner area of the aperture and lip pigmented a pale brown and having the columellar fold greatly developed.

RECORDS.—Guadalcanar: (Paravicini).

Placostylus (Placocharis) paravicinianus
B. Rensch

Figure 1

Placostylus paravicinianus B. RENSCH, 1934, Sitz. Gessell. Natur. Freunde, p. 451 (Aola, Guadalcanar).—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 79, Pl. I, fig. 7.

DESCRIPTION.—Shell elongate - ovate, rather solid, rimately perforate. Color of first 4 1 2 whorls a brick-red, shading into a brownish red on the fifth whorl. Whorls 6, decidedly convex. Spire with the tip (2 whorls) pitted. Aperture ovate. Parietal wall thinly glazed with white. Columellar fold strong but not excessively developed. No parietal tooth. Outer lip reflexed. Sutures slightly indented. Sculpture, other than the pitting on the early whorls, consisting of fine growth lines on the body whorl which are somewhat coarser just below the suture and in addition are slightly recurved at this point. Mid-whorls showing faint malleations. Aperture cast at an angle of 15° from the vertical, spire forming an angle of 45°.

LENGTH	WIDTH	APERTURE
68	31.5	30.5 × 15 mm.

Paratype

PARATYPE.—Mus. Comp. Zool. No. 93958, Island of Guadalcanar, Solomon Islands. Dr. E. Paravicini, collector.

REMARKS.—*P. paravicinianus* does not appear to be closely related to any other species. It is sharply differentiated by the strong convexity of the early whorls and its rather deep red and brownish-red coloration. The lack of a parietal tooth is quite different from all other large forms in the subgenus *Placocharis*. A second paratype sent by Dr. Paravicini is deformed and as a consequence not measured.

RECORDS.—Guadalcanar: Aola (Rensch).

Placostylus (Placocharis) macfarlandi
(Brazier)

Bulimus (Eumecostylus) macfarlandi BRAZIER, 1875 [1876], Proc. Linn. Soc. New South Wales, I, p. 4 (Solomon Archipelago).—PFEIFFER, 1877, Mono. Heliceorum Viven., VIII, p. 604.—COX, 1888, Proc. Linn. Soc. New South Wales, (2) II, pt. 4, p. 1063, Pl. XXI, fig. 7.

Bulimus macfarlandi (sic) "Cox" PAETEL, 1873, Catalog der Conchy.-Samml., p. 98.

Placostylus macfarlandi, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 67, Pl. XVI, figs. 3-4;

not *P. macfarlandi*, Kobelt, idem, p. 33, Pl. VIII, figs. 2-3 [= *P. founaki*].

Placostylus (Placocharis) macfarlandi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 83, Pl. XXXV, fig. 20.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 407.

Bulimus brodiei "Brazier" PILSBRY, 1900, Man. of Conch., (2) XIII, p. 83 [nomen nudum].

REMARKS.—A single specimen was obtained by Eyerdam that seems referable to this species. It is a dead shell but possesses sufficient coloration to characterize it as this form.

RECORDS.—Malaita: Aurola at 3000 feet (Whitney).

NOTES.—Found in a native's garden: terrestrial (Eyerdam).

Placostylus (Placocharis) macgillivrayi
(Pfeiffer)

Bulimus macgillivrayi PFEIFFER, 1855, Proc. Zool. Soc. London, p. 108, Pl. XXXII, fig. 2 (Wanderer Bay, Guadalcanar); 1859, Mono. Heliceorum Viven., IV, p. 379.—CROSSE, 1864, Jour. de Conch., XII, p. 134.

Bulimus (Placostylus) macgillivrayi, PFEIFFER, 1855 [1856], Malak. Blatt., II, p. 148.

Eumecostylus macgillivrayi, ALBERS, 1860, Die Heliceen, p. 186.

Placostylus macgillivrayi, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 72, Pl. XVII, figs. 4-5.

Placostylus (Placocharis) macgillivrayi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 84, Pl. XXXVI, figs. 27-30.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 408.

REMARKS.—A small species differing quite sharply from all other species in this subgenus. It has not been obtained by recent collectors.

RECORDS.—Guadalcanar: Wanderer Bay (Pfeiffer).

Placostylus (Placocharis) stutchburyi
(Pfeiffer)

Bulimus stutchburyi PFEIFFER, 1860, Proc. Zool. Soc., London, p. 137, Pl. LI, fig. 9 (Erumanga, New Hebrides); 1861, Malak. Blatt., VIII, p. 12; 1868, Mono. Heliceorum Viven., VI, p. 23.—CROSSE, 1864, Jour. de Conch., XII, p. 142 [reference only].

Placostylus stutchburyi, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 135, Pl. XXXII, fig. 8.

Placostylus scottii var. *mendanae* KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 133, Pl. XXXII, figs. 6-7 (Solomon Islands).

Placostylus (Placocharis) stutchburyi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 88, Pl. XXXVI, figs. 35-37.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 408.

REMARKS.—Very close in general appearance to *P. palmarum* (Mousson), differing slightly in the more elongated aperture and the more brilliant periostracum.

The type locality given by Pfeiffer is unquestionably wrong. Pilsbry (*op. cit.*, p. 88), quotes Brazier as giving New Georgia as the locality. A single lot, M.C.Z. No. 62042, is from Russell Island.

RECORDS.—New Georgia: (Pilsbry, Kobelt). Russell Isl.: (M.C.Z.).

Placostylus (Placocharis) palmarum
(Mousson)

Bulimus palmarum MOUSSON, 1869, Jour. de Conch., XVII, p. 62, Pl. iv, fig. 5 (Makite, San Christoval).—PFEIFFER, 1877, Mono. Heliceorum Viven., VIII, p. 28.—KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 41 [description only; not the figures, which are *P. minor* Kobelt].

Placostylus palmarum minor KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 42, Pl. ix, figs 6-9 [description refers to *P. palmarum* (Mousson), the remarks and figures to *P. minor* Kob.], *non minor* Kobelt, 1891, p. 21, nor Brazier, 1895.

Placostylus (Placocharis) palmarum, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 85, Pl. xxxvi, figs. 31-32.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 408.

Placostylus (Placocharis) palmarum minor, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 86, Pl. xxxvi, figs. 33-34.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 408.

Placostylus palmarum, DATTENBERG, 1910, Jour. de Conch., LVIII, p. 25.—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 78.

REMARKS.—There is considerable uncertainty relative to the species. The variety *minor* Kobelt differs but slightly from the form described by Mousson. Additional material is needed for a better understanding of this as well as other closely related forms. The localities listed below are not consistent with the distribution of other members of this genus and would indicate an error in the original assignment of localities. Neither Mann nor Eyerdam obtained *P. palmarum* on the island of San Christoval. Paravicini collected specimens at Domma, Guadalcanar, and it may occur on Savo which is close to this latter island. If the variety *minor* Kobelt is found to be valid, the name will have to be changed, as Kobelt used the

name on a previous page (21) for a variety of *P. similis* from New Caledonia.

RECORDS.—Guadalcanar: Domma (Paravicini). San Christoval: Makite (Mousson) [questioned]. Savu [= Savo]: (Rensch; Pilsbry, as *minor*).

Placostylus (Placocharis) strangei
(Pfeiffer)

Bulimus strangei PFEIFFER, 1855, Proc. Zool. Soc. London, p. 8 (Eddystone Island).—PFEIFFER, 1856, Novit. Conch., I, p. 54, Pl. xvi, figs. 11-12; 1859, Mono. Heliceorum Viven., IV, p. 378.

Bulimus (Placostylus) strangei PFEIFFER, 1855 [1856], Malak. Blatt., II, p. 148.

Placostylus strangei, FRAUNFELD, 1869, Verh. Zool. Botan. Gesell., XIX, p. 874.—KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 23, Pl. v, figs. 4-6.

Placostylus (Placocharis) strangei, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 87, Pl. xxxiv, figs. 15-17.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 408.

REMARKS.—Materially different from *P. palmarum* in possessing a more attenuated spire and in having a lighter though redder periostracum.

RECORDS.—Eddystone [Narovo]: (Pfeiffer; Pilsbry). Gizo: (C. M. Cooke); New Georgia: (C. M. Cooke); Rubiana (J. H. Waterhouse, M.C.Z. No. 79248).

Placostylus (Placocharis) sellersi (Cox)

Bulimus sellersi Cox, 1871, Proc. Zool. Soc. London, p. 644, Pl. LI, fig. 3 (Guadalcanar).—PFEIFFER, 1877, Mono. Heliceorum Viven., VIII, p. 31.—BRAZIER, 1889, Jour. of Conch., VI, p. 79.

Bulimus (Eumecostylus) sellersi, PAETAL, 1873, Catalog der Conchy.-Samml., p. 98.

Placostylus sellersi, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 55, Pl. xiii, figs. 6-7.—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 74.

Placostylus (Aspastus) sellersi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 95, Pl. xxxviii, figs. 56-57.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 416.

REMARKS.—This species is entirely white and a little smaller than *P. strangei*. Pilsbry (*loc. cit.*) placed this species in the subgenus *Aspastus*, but a critical examination, based in particular on the parietal area, indicates it to be an extreme in the subgenus *Placocharis*. It approaches quite closely the general outline of *P. strangei*, differing in being proportionately narrower, being white and not pale brown

as in the latter species, and not possessing a parietal tooth of any size. Only two out of the eighteen specimens possess a tooth. In *P. strangei*, the parietal tooth is very well developed. The following measurements are from a series of four cotypes from Cox (M.C.Z. No. 26051):

LENGTH	WIDTH	APERTURE
47.5	18.0	21.0 × 9.5 mm.
49.0	19.5	21.5 × 9.5
45.0	18.0	20.0 × 8.0
43.0	17.5	19.0 × 7.0

RECORDS.—Guadalcanar: (Brazier; Cox); Domma (Paravicini); Rotalu; Gamba; Domma; Aola (Rensch).

SUBGENUS MALAITELLA, NEW NAME

Acrostylus CLENCH, 1935, Nautilus, XLVIII, p. 129, non Cossmann, 1896.

SUBGENOTYPE.—*Placostylus acutus* Clench.

The subgenus is characterized by shells possessing a single color (red, reddish brown or greenish), acute spires with flat to slightly convex whorls and the lip of the aperture colored white or red. No secondary coloration, such as stripes or blotches occur in the species so far described.

Placostylus (Acrostylus) ophir, new species

Figure 9

DESCRIPTION.—Shell medium in size, depressed dorso-ventrally, umbilicate, the umbilicus in part covered by the columellar fold. Color a light olivaceous green, darkest on the body whorl. A slight diffusion of red occurs just below the lip. Peristome red, the color extending slightly into the basal area of the columella. Early whorls whitish. Whorls 5, strongly convex, first 2 1/2 pitted. Spire produced. Aperture ovate. Parietal wall calloused and possessing a single rounded tooth. Outer lip reflected. Columella slightly spiral, ridged, and producing, as in *Proaspatius*, a small false umbilicus (this is in addition to the usual umbilical orifice). Sculpture, besides the pitting on the first 2 1/2 whorls, consisting of fine irregular growth lines. Very faint traces of spiral sculpture consisting of fine incised lines on the mid-whorls. Sutures well indented. Spire produced at 43°. Aperture cast at an angle of 18° from the vertical.

LENGTH	WIDTH	APERTURE	
68	29.0	31.5 × 16.5 mm.	Holotype
67	30.0	32.0 × 15.0	Paratype
62	27.5	29.5 × 14.5	"
64	28.0	31.0 × 15.5	"
60	27.5	29.0 × 15.0	"

HOLOTYPE.—A.M.N.H. No. 79005, 20 miles inland from Su'u, Malaita Island, Solomon Islands. W. J. Eyerdam collector, March, 1930. Paratypes in the A.M.N.H. and the M.C.Z. from Su'u and Aurola, Malaita.

REMARKS.—The olivaceous periostracum of this species is very thin and scales off readily on dead shells. There is little or no trace of spiral sculpture.

RECORDS.—Malaita: Su'u; 20 miles from Su'u; Aurola at 2500–3000 feet (Whitney).

Placostylus (Acrostylus) malaitensis, new species

Figure 4

DESCRIPTION.—Shell medium in size, depressed dorso-ventrally, imperforate to minutely perforate, smooth. Color olivaceous brown, reddish just below the aperture margin. Early whorls brownish to dull reddish, the color being invested in the lime of the shell. The periostracum on the early whorls worn off. Spire produced, the sides more or less flattened. Whorls 5 1/2 to 5 3/4, flattened, first 2 1/2 pitted. Aperture ovate. Peristome simple, thickened within but not noticeably expanded, colored a deep red to a brick-red. Parietal wall calloused and supporting a large rounded tooth in the mid-area. Columella with a slight basal ridge and only very slightly inclined toward spiral development and, as a consequence, no false umbilicus is indicated. Sutures not indented to any extent though they are sharply defined. Sculpture of very fine growth lines and pitted early whorls. Spiral sculpture not in evidence on the adult shells in the type series though faintly traceable on a single immature specimen. Spire produced at 32° to 40°. Aperture cast at 90° from the horizontal.

LENGTH	WIDTH	APERTURE	
77.5	32.5	34.0 × 18.5 mm.	Holotype
66.5	33.0	33.0 × 17.5	Paratype
67±	33.0	32.5 × 20.0	"
64.0	31.0	29.0 × 15.0	"

HOLOTYPE.—A.M.N.H. No. 79006, near Su'u, Malaita Island, Solomon Islands, at 400 feet. W. J. Eyerdam, collector, March, 1930. Paratypes, A.M.N.H. and the M.C.Z. from Aurola, Malaita, at 3000 feet.

REMARKS.—Related to *P. ophir* but differing from that species in several of its characters. Specimens of this species are a little larger, have different proportions in the measurements of aperture to length of shell, a smaller true umbilicus (or even being imperforate) and have a simple lip. The flat-sided whorls in this species differ from the more convex whorls

of *P. ophir*. Other than the holotype, the spire of this species is much more obtuse.

In general, there seems to be considerable variation in the Solomon Island *Placostylus* regarding their length. In the measurements given above for this species, it is to be noted that though the holotype is a little over 10 mm. longer than any of the paratypes, the remaining measurements are approximately the same. Other species seem to vary the same way, having disproportionate lengths in relationship to their other measurable characters.

RECORDS.—Malaita: near Su'u; Aurola at 3000 feet (Whitney).

Placostylus (Acrostylus) acutus Clench

Figure 5

Placostylus (Acrostylus) acutus CLENCH, 1935, *Nautilus*, XLVIII, p. 126, Pl. VII, fig. 6 (Wanderer Bay, Guadalcanar, Solomon Islands).

DESCRIPTION.—Shell rather thick, rimately umbilicate, elongate and depressed dorso-ventrally. Color of shell pale reddish brown, periostracum a deep reddish brown. Whorls 5 3.4, rather convex. Spire produced and sharply tapering. Aperture ovate. Peristome grayish in color and very sharply reflexed, with a definite thickening within the aperture. Parietal wall calloused and supporting a very strong tooth. Columella spirally developed, its basal portion thickened and forming a false lamella. Sutures indented. Sculpture of fine irregular growth lines with faint malleations on the body whorl. Spire forms an angle of 42°, aperture cast at an angle of 14° from the axis.

LENGTH	WIDTH	APERTURE
67.5	31	30 × 13 mm. Holotype

HOLOTYPE.—M.C.Z. No. 93953, Wanderer Bay, Guadalcanar, Solomon Islands. E. Paravicini collector.

REMARKS.—In relationship, this form appears to resemble most closely *P. calus* Smith from Malaita. It differs from that species in being smaller, having more convex whorls and a more rounded aperture. From *P. ophir*, Clench, the only other species it at all approximates, it differs by being reddish in color and not green and

the spire is more attenuated and the shell more solid in structure.

Placostylus (Acrostylus) calus Smith

Placostylus calus SMITH, 1891, *Proc. Zool. Soc. London*, p. 489, Pl. XL, fig. 7 (Solomon Islands).

Placostylus (Placocharis) calus, PILSBRY, 1900, *Man. of Conch.*, (2) XIII, p. 83, Pl. XXXV, fig. 20.—CLAPP, 1923, *Bull. Mus. Comp. Zool.*, LXV, p. 407.

REMARKS.—The series of this species from several localities indicate that there is a fair amount of size variation. There is a strong peristome notch developed on the upper inner edge of the lip. This character is not exhibited by Smith in his figure. This feature is very well developed in the typical *Placostylus* from New Caledonia.

RECORDS.—Malaita: Kivarambara; Su'u; Aurola; Ulimburi (Whitney).

NOTES.—In gardens and on forest floor from the coast to elevations of 2500 feet (Eyerdam).

Placostylus (Acrostylus) unicus

B. Rensch

Placostylus unicus B. RENSCH, 1934, *Sitz. Gesell. Natur. Freunde*, p. 452 (Moravo Lagoon, New Georgia). I. AND B. RENSCH, 1935, *Revue Suisse de Zoologie*, XLII, p. 80, Pl. I, fig. 8.

REMARKS.—I have not seen this species. It appears to be a member of *Acrostylus*, and the only species in this subgenus occurring outside of Malaita.

PROASPASTUS, NEW SUBGENUS

Characterized by a wavy-malleated spiral sculpture, a spiral columellar axis, usually a light primary color with greenish to greenish bronze, tent-shaped blotches which are arranged generally in an axial pattern.

SUBGENOTYPE.—*Bulimus sanchristovalensis*, Cox.

This group seems to be connected with *Aspastus* by a somewhat similar shape, to *Eumecostylus* by its spiral axis (though this character is developed to a limited extent in *Placocharis*) and to *Placocharis* by its sculpture. Its type of coloring is more or less peculiar though not entirely so. There are no complete intergrades between *Proaspastus* and the other subgenera of *Placostylus* from the Solomon Islands. Other than in shape it appears to bear a strong relationship to *Callistocharis* from

the Fiji Islands, both in its type of coloring and in its sculpture. Species in this group are arboreal as far as known.

Placostylus (Proaspastus) hargravesi
(Cox)

Bulimus hargravesi Cox, 1871, Proc. Zool. Soc. London, p. 323, Pl. xxxiv, fig. 3 (Treasury Island).—BRAZIER, 1889, Jour. of Conch., VI, p. 78 (Ulawu or Contranete Island, Solomon Islands).

Placostylus (Charis) hargravesi, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 38, Pl. ix, figs. 2-3.

Placostylus (Placocharis) hargravesi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 93, Pl. xxxviii, figs. 49-51.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 409.

Placostylus hargravesi, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 75.

REMARKS.—It is questionable whether Treasury Island is the type locality for this species. The subgenus *Proaspastus*, as far as all present data indicate, is limited in its distribution to the lower chain of islands, namely, Malaita, San Christoval, Guadalcanar and the few small associated islands. Additional collecting may extend the present range of the subgenus, but probably not to the islands north of those named above. Treasury Island is approximately 350 miles distant from the nearest definitely known locality for the subgenus.

Brazier (1889, p. 78) gives Ulawa Island for this species. In this he is entirely wrong, as his remarks deal with *P. scottii* and not *P. hargravesi* with which he was confused. The species is entirely confined to Malaita Island.

RECORDS.—Malaita: Su'u; 6 miles, at 400 feet, and 10 miles, 1500 feet, from Su'u; Ulumburi; Auki; (Whitney): Malamaniki; Buma (Parevincini; Rensch); Tai Lagoon (C. M. Cooke). Treasury: (Cox) questioned.

Placostylus (Proaspastus) hargravesi
heimburgi Kobelt

Placostylus hargravesi var. *heimburgi* KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 38, Pl. viii, figs. 6-7.

Placostylus (Placocharis) hargravesi heimburgi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 93, frontispiece, Fig. 5.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 410.

Placostylus (Placocharis) hargravesi aukiensis CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 409, Fig. 49 (radula), (Auki, Malaita).

REMARKS.—The variety *aukiensis* described by Clapp seems to be an absolute synonym of this subspecies. The form *heimburgi* itself is questionable as it intergrades completely with the typical form. Clapp (p. 409) intimated that *aukiensis* was more or less an ecological form.

RECORDS.—Malaita: Kivarambara (Whitney); Auki (Clapp, as *aukiensis*).

Placostylus (Proaspastus) sanchristovalensis
(Cox)

Bulimus sanchristovalensis Cox, 1870, Proc. Zool. Soc. London, p. 172, Pl. xvi, fig. 7 (San Christoval Island).—PFEIFFER, 1877, Mono. Heliceorum Vivent., VIII, p. 27.

Bulimus christovalensis, BRAZIER, 1889, Jour. of Conch., VI, p. 77 (Recherch Bay, San Christoval Isl., Solomon Islands), *nomen nudum*, suggested by Brazier to replace *sanchristovalensis* Cox.

Placostylus sanchristovalensis, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 34, Pl. viii, figs. 4-5.

Placostylus (Eumecostylus) sanchristovalensis, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 97, Pl. xxxvii, fig. 48.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 413.

Placostylus sanchristovalensis, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 76.

REMARKS.—A species closely related to *P. hargravesi*. Pilsbry placed this species in *Eumecostylus* because of the spiral development of the columella which has produced a false umbilicus. This character is not, however, peculiar to any subgenus. All other characters place it in this subgenus.

RECORDS.—San Christoval: (Cox); Wai-Beroni (Paravicini; Rensch).

Placostylus (Proaspastus) vicinus B.
Rensch

Figure 8

Placostylus sanchristovalensis vicinus B. RENSCH, 1934, Sitz. Gesell. Natur. Freunde, p. 452 (Aola, Guadalcanar).—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 76 Pl. I, fig. 5.

DESCRIPTION.—Shell elongate, fairly solid, subperforate. Color of the early four whorls a deep pink, the color impregnated in the body of the lime. From the fifth whorl onward, the basic color in the shell proper shades into white. This white coloration is entirely concealed by

the periostracum which covers the later whorls. The periostracum is colored a yellowish brown with zigzag, axial streaks of a much deeper brown. Whorls 5 1 2-6, and somewhat convex. Spire attenuated and rather acute, tip punctate. Aperture ovate with a strongly reflexed lip. Columellar fold strong, the columella spirally developed. Parietal wall thinly glazed and supporting a well-developed tooth which is set at right angles to the face of the aperture. Sutures only slightly impressed. Sculpture of irregular, spirally arranged and somewhat lengthened malleations, the ridges between these malleations incised by fine axial growth lines. Aperture cast at an angle of 15° from the vertical, spire forming an angle of 36° .

LENGTH	WIDTH	APERTURE	
62 5	27.5	28 5 \times 13 5 mm.	Paratype
65 0	28.5	30 0 \times 13 5	"

REMARKS.—In general appearance this species is closely related to *P. sanchristovalensis* Cox from the island of San Christoval. It differs from that species in being smaller, having a slightly darker coloration, possessing a parietal tooth and having a much stronger columellar fold. It differs from *P. hargravesi* Cox (Malaita) in being a little larger, having less convexity to its whorls and possessing the parietal tooth, which is lacking entirely in the latter species.

RECORDS.—Guadalcanar: Aola (Paravicini); Aola; Rotalu (Rensch).

Placostylus (Proaspastus) scottii (Cox)

Bulimus (Eumecostylus) scottii Cox, 1873, Proc. Zool. Soc. London, p. 152 (Solomon Islands).

Placostylus (Placocharis) scottii, PILSBRY, 1900, Man. on Conch., (2) XIII, p. 90, Pl. XXXVII, figs. 38-39.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 409.

REMARKS.—This species is smaller and has less color than any other in the subgenus *Proaspastus*. A very large series was collected by Eyerdam on the island of Ulawa which lies about 50 miles north of the center of San Christoval. This establishes the first specific island for this species. Brazier (1889, p. 78), erroneously referred this record to *P. hargravesi* Cox.

LENGTH	WIDTH	APERTURE
49 5	24 0	28 \times 12 0 mm.
48 0	22 5	27 \times 12 0
49 0	23 0	28 \times 12 5
48 5	23 5	26.5 \times 11 5
51 0	22 5	26 0 \times 11 5

RECORDS.—Ulawa: (Whitney, April, 1930).

Placostylus (Proaspastus) uliginosus "v. Heimburg," Kobelt

Placostylus (Charis) uliginosus "v. Heimburg," KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 73, Pl. XVII, figs. 6-7 (Solomons).

Bulimus (Placostylus) hobsoni Cox, 1892, Proc. Linn. Soc. New South Wales, (2) VI, p. 567, Pl. XX, figs. 2-3 (Malanta [Malaita] Island, Solomon Islands).

Placostylus (Placocharis) uliginosus, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 91, Pl. XXXVII, figs. 46-47.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 409.

Placostylus founaki uliginosus, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 77.

REMARKS.—This form bears a close relationship to *P. scottii*, differing generally in possessing a red rather than a yellowish coloration.

P. hobsoni Cox was tentatively considered a synonym by Pilsbry, and it is here placed under *P. uliginosus*, though it is still questionable as to its exact status. The descriptions tally but there is a difference in the size. However, the size character does vary considerably in certain of these forms and the species described by Cox is probably only a larger form.

RECORDS.—Malanta [Malaita]: (Cox, as *P. hobsoni*): Maka (Rensch).

Placostylus (Proaspastus) almiranta, new species

Figure 7

DESCRIPTION.—Shell elongate-ovate, fairly thin, subperforate. Color an olivaceous green, with faint (holotype) to strong (paratype) irregular axial bars of deep brown, discontinuous and very irregular on the early whorls. First to fourth whorls a dull reddish brown to light brown. Whorls 5, rather convex. Spire somewhat produced, acute and punctate on the first 2 1/2 whorls. Aperture ovate with a slightly reflexed lip. Parietal wall thinly glazed and supporting a small tooth. Sutures impressed. Sculpture of fine, spirally arranged and lengthened malleations crossed by fine growth lines. Aperture cast at an angle of 16° from the vertical, spire forming an angle of 38° .

LENGTH	WIDTH	APERTURE	
58	26 0	31 × 12 0 mm.	Holotype
50	22 5	29 × 11 5	Paratype

HOLOTYPE.—A.M.N.H. No. 79009, at an elevation of 1500 feet, 10 miles from Su'u, Malaita, Solomon Islands, Whitney Exp., March, 1930. Paratype, M.C.Z. 93001, with the same date.

REMARKS.—*P. almiranta* is quite different from all other members of this subgenus. It appears to be most closely allied to *P. hargravesi*, but differs from that species in being more ovate in outline, darker in coloration, possessing bars of color over the ground pigmentation (rather than the tentlike marks) and having a much less acute spire. The more rounded contour of the spire in this new species is sharply different from all other species from Malaita in this subgenus, though approximating this character in *P. gallegoi* from San Christoval.

Placostylus (Proaspastus) gallegoi, new species

Figure 6

DESCRIPTION.—Medium sized, rimately perforate, long-ovate, solid. Color reddish brown, marked with blotches of darker red-brown on the earlier whorls. These blotches are axial in their arrangement. First three whorls brick red and usually devoid of periostracum, not pitted, but this is probably due to the early whorls being worn. Whorls 6, slightly convex. Spire extended and pointed. Aperture ovate, only very slightly flaring at the base. Palatal lip reflected, white or slightly tinged with pale brown-yellow. Parietal wall thinly calloused. A single parietal tooth developed midway and slightly lengthened at right angles to the face of the aperture. Columella continued smoothly as a fold into the base of the reflected lip. Sutures very slightly impressed. Sculpture similar to that of *P. kirakiraensis* Rensch but finer. Spire forming an angle of 47°. Aperture cast at an angle of 14° from the vertical.

LENGTH	WIDTH	APERTURE	
67.0	29.0	28.5 × 13.0 mm.	Holotype
66.5 ¹	28.5	30.0 × 13.5	Paratype
68.5 ¹	28.0	29.0 × 12.0	"
70.5 ¹	27.5	30.5 × 12.0	"
66.5 ¹	29.0	29.0 × 13.0	"

HOLOTYPE.—A.M.N.H. No. 79003, Mountains of San Christoval, Solomon Islands, Eyerdam and Mayr, collectors, Dec. 1929. Paratypes A.M.N.H. No. 72004 and M.C.Z. No. 92901.

¹ Spire broken, with an approximate loss of 2 mm.

REMARKS.—Closely allied to *P. kirakiraensis* in shape and sculpture but differing materially in both size and color. There is no intergradation between the two species. A single specimen (M.C.Z. 32447) collected by Mann, was labeled as new by Clapp but not described.

RECORDS.—San Christoval: mountains at 1800 feet; near Kavo River (Whitney); Pamua (Mann).

Placostylus (Proaspastus) kirakiraensis
B. Rensch

Figure 3

Placostylus sanchristovalensis kirakiraensis B. Rensch, 1934, Sitz. Gesell. Natur. Freunde, p. 452.—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 76, Pl. I, fig. 6.

DESCRIPTION.—Rather large, long-ovate, minutely rimate to imperforate. Color dark yellow-brown with patches of irregular dark brown axial markings on the body whorl. Remaining whorls reddish brown. Early whorls devoid of periostracum and colored a dull red-brown. Whorls 6, slightly convex. Spire pointed and produced. Aperture ovate with the basal area somewhat flaring. Palatal lip reflected and somewhat thickened, colored with a brownish tinge. Parietal wall ridged at its lower portion by the spiral columella, thinly calloused though somewhat thickened just above the columellar fold. A small subcentral tooth is located on the parietal wall and set at right angles with the face of the aperture. Columella a thin fold and continued as a spiral fold to the apex (similar in structure to the columella in the subgenus *Eumecostylus*). Sutures somewhat indented. Sculpture of slightly developed, widely spaced axial ridges in addition to very fine microscopic hairlike axial incised lines. Spiral sculpture of coarse and rather elongated malleations. Aperture case at an angle of 13° from the vertical, spire forming an angle of 48°.

LENGTH	WIDTH	APERTURE	
87 0	36 0	37.5 × 18 0 mm.	Paratype
86 5	36.0	36.5 × 19.0	"
92 0	38.0	41.5 × 19.0	"
88 0	36 5	37.5 × 19 0	"
89 5	35.5	36.5 × 18 5	"

REMARKS.—This species is the largest in the subgenus and also the darkest in coloration of the forms so far described. The sculpture is very strongly developed. In relationship it appears to be near to *P. gallegoi*, differing from that form in its much larger size, its darker coloration and being much thinner in structure.

RECORDS.—San Christoval: mountains at 1800 feet (Whitney); Kira Kira (Paravicini; Rensch).

NOTES.—Rare, found on the ground in forests and gardens. These snails are eaten by dogs (Eyerdam).

SUBGENUS *EUMECOSTYLUS* ALBERS

ALBERS, 1861, Die Heliceen, p. 186.

SUBGENOTYPE.—*Bulimus cleryi* Petit.

Usually rather large shells, more or less parallel sided with a dark and generally thin greenish or reddish-brown periostracum. The lime proper of the shell is impregnated with a strong reddish pigment. The columella is generally in a wide spiral which allows a view through to the apex. This structural feature produces the "false umbilicus." The pitting on the early whorls varies to some extent and does not cover three and one-half whorls in all species as usually quoted.

The subgenus *Eumecostylus* appears to be definitely related to *Euplacostylus* of the Fiji archipelago and both have probably evolved from some similar stock. A parallel condition also exists between *Proaspastus* (Solomon) and *Callistocharis* (Fiji). The lack of similar elements in the *Placostylus* fauna of New Caledonia would indicate that these four groups evolved after the land connection had been severed between New Caledonia and the islands to the north, but before the Fijian connection had separated from the Solomons.

Placostylus (Eumecostylus) cleryi Petit de la Saussaye

Bulimus cleryi PETIT, 1850, Jour. de Conch., I, p. 56, Pl. iv, fig. 1 (Solomon Islands).—PFEIFFER, 1853, Mono. Heliceorum Viven., III, p. 306; idem, 1859, IV, p. 369; idem, 1868, VI, p. 13; idem, 1877, VIII, p. 27; 1886, Conchy.-Cab., I, pt. 13A, Sec. 1, p. 243, Pl. LXV, fig. 3.—CROSSE, 1864, Jour. de Conch., XII, p. 133.—BRAZIER, 1889, Jour. of Conch., VI, p. 77.

Bulimus (Placostylus) cleryi, PFEIFFER, 1855 [1856], Malak. Blatt., II, p. 148.—SMITH, 1885, Proc. Zool. Soc. London, p. 594.—GUPPY, 1887, The Solomon Islands and Their Natives, London, I, p. 345.

Otostomus (Aspastus) cleryi, H. AND A. ADAMS, 1858, The Genera of Recent Moll., II, p. 151.

Eumecostylus cleryi, ALBERS, 1860, Die Heliceen (2nd Ed.), p. 186.

Placostylus (Eumecostylus) cleryi, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 96, Pl. XL, figs. 68-70.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 412.

Placostylus cleryi cleryi, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 82.

REMARKS.—This is the largest of the Solomon Island species. A specimen obtained by Eyerdam measured 112 mm. in length. The olivaceous green periostracum is usually lost in adult shells leaving a dull reddish surface. Two nearly mature specimens (M.C.Z. 26057, Pease Coll.), possess a solid green coloration on later whorls.

RECORDS.—San Christoval: Wano or Wanga, NE. side of S. Christoval (Brazier); Makira Harbor (Brazier; Crosse); Koofeh district (Smith); Wainoni Bay (Clapp); Star Harbor and 20 miles south of Kira Kira (Whitney); Kira Kira (Paravicini; Rensch).

NOTES.—Dr. Mann informs me that the specimens he obtained (Wainoni) were found on palm trees, and Guppy (1887, p. 338) learned from the natives that they exist only in the foliage of the high trees. Guppy did not obtain any live material.

Placostylus (Eumecostylus) cleryi *cookei*, new subspecies

DESCRIPTION.—Similar to *P. cleryi* other than in color. In this form the periostracum on the adult shells is reddish brown with irregular small dark brown blotches somewhat axially arranged. There is no green coloration at all as appears on the typical form. Sculpture of rather fine spiral malleations with the surface of shell rather shining.

LENGTH	WIDTH	APERTURE	
103	32	49 × 14 mm.	Holotype

HOLOTYPE.—M.C.Z. No. 65996, Waiai, San Christoval, Solomon Islands. W. M. Mann, collector, 1918. Paratypes, M.C.Z. No. 32443 from the same locality.

Named for C. M. Cooke.

Placostylus (Eumecostylus) phenax
Clapp

Placostylus (Eumecostylus) phenax CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 412, Pl. v, figs. 3-4 (Wainoni Bay, San Christoval).

Placostylus cylindricus phenax, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 51.

REMARKS.—As noted by Clapp, this species is much smaller than *P. deryi*, and it possesses in addition a coarser sculpture of spiral malleations. It differs from *P. cylindricus* by being a little larger, having a coarser sculpture and having the outer edge of the aperture comparatively straight. The color of *P. cylindricus* differs in being a greenish brown and not reddish brown as in *P. phenax*.

RECORDS.—San Christoval: Wainoni Bay (Clapp; Whitney); Kira Kira (Paravicini; Rensch).

Placostylus (Eumecostylus) fraterculus
B. Rensch

Figure 2

Placostylus deryi fraterculus B. RENSCH, 1934, Sitz. Gesell. Natur. Freunde, p. 451 (Domma, Guadalcanar).—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 83, Pl. I, fig. 9.

DESCRIPTION.—Shell narrow, elongate and imperforate. (Two specimens have the lip incompletely cemented to the body whorl, leaving a minute rimation.) Color olivaceous to reddish brown on the last two whorls, the early whorls pinkish red which, in turn, merges into the coloration of the later whorls. Spire produced, forming an angle of 54°. Whorls 6 to 6 1, 8 rather convex and slightly irregular. First two whorls minutely pitted. Aperture auriculate, its face nearly parallel with the axis. Peristome slightly reflexed, white and slightly thickened about midway along the palatal side. Parietal wall thinly calloused and toothless, columella produced in a wide spiral which is plicated in the parietal area. Sculpture of fine irregular growth lines crossed by fine irregular incised spiral lines, the two early whorls possessing only the pitted surface.

LENGTH	WIDTH	APERTURE	
70 5	25 0	26 5 X 9 0 mm.	Paratype
64 0	26 0	27 5 X 10 0	"
69 5	26 5	29 5 X 11 0	"
63 5	25 0	25 0 X 10 5	"
66 5	22 5	25 5 X 8 0	"

REMARKS.—This species is closely related to *P. cylindricus* from Ysabel Island. It differs only slightly from that species in the general contour and in having more convex whorls. It is related to *P. phenax* from San Christoval as well but there are much sharper differences. *P. phenax* is much larger, possesses a parietal tooth, has a more or less distorted aperture, a differently shaped spire and it has a coarser sculpture.

RECORDS.—Guadalcanar: Damma (Paravicini).

Placostylus (Eumecostylus) cylindricus
Fulton

Placostylus (Euplacostylus) cylindricus FULTON 1907, Ann. Mag. Nat. Hist., (7) XIX, p. 154, Pl. x, fig. 3 (Isabel Island, Solomons).—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 412.

Placostylus cylindricus, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 81.

REMARKS.—This species belongs to the subgenus *Eumecostylus*. Clapp (*op. cit.*, p. 413) intimated that this was its position but did not list it as such on p. 412. Both this species and *phenax* are probably derivations of the same stock which have become differentiated through isolation.

It is to be noted that all species in the subgenus *Eumecostylus* exhibit a very wide range in aperture shape. No two specimens are exactly alike and in some the general apertural shape is materially altered from the usual.

It appears to be questionable whether or not this species occurs on both of these islands as indicated in the records below. As the records of Rensch are well localized, and the material originally described by Fulton had only an island indication, it is possible that Fulton's record was an error.

RECORDS.—Ysabel: (Fulton); Guadalcanar: Rotala and Aola (Rensch).

Placostylus (Eumecostylus) kreffti (Cox)

Bulimus (Charis) kreffti COX, 1872, Proc. Zool. Soc. London, p. 19, Pl. iv, fig. 4 (Solomon Islands).

Bulinus kreftii, PFEIFFER, 1877, Mono. Heliceorum Viven., VIII, p. 27.—BRAZIER, 1889, Jour. of Conch., VI, p. 79.

Placostylus kreftii, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 132, Pl. xxxii, fig. 4 [?5].

Placostylus (Placocharis) kreftii, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 81, Pl. xxxv, figs. 23, 25.—CLAPP, 1923, Bull. Mus. Zool., LXV, p. 407.

Placostylus (Placocharis) artus CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 410, Pl. iv, figs. 7-8 (Florida Island).

REMARKS.—*P. artus* Clapp is this species, without question. The holotype (M.C.Z. 32448) is an abnormal specimen of *P. kreftii*, the two paratypes are similar in detail to the figure of *kreftii*. Specimens of this species collected by Eyerdam agree in all respects with the figure and description of Cox.

This species is placed in the subgenus *Eumecostylus* and not *Placocharis* as it has been considered. It agrees in sculpture, general outline and in the spiral twist of the columella with other members of this subgenus.

RECORDS.—Florida: (Brazier; Whitney); (Clapp, as *P. artus*).

NOTES.—Found in forest near the coast (Eyerdam).

SUBGENUS ASPASTUS ALBERS

Aspastus ALBERS, 1850, Die Heliceen, p. 149. SUBGENOTYPE.—*Bulinus miltocheilus* Reeve.

White or yellow shells usually axially ridged and not possessing any spiral or malleated sculpture. Spire produced and whorls flat sided with the axis not noticeably spiral. There is no parietal tooth developed though the columellar plication is usually well pronounced. Arboreal. This subgenus is limited to Ulava and San Christoval and its coastal islands.

Placostylus (Aspastus) miltocheilus (Reeve)

Bulinus miltocheilus REEVE, 1848, Conch. Icon, V, *Bulinus*, Pl. XLIX, fig. 322 (San Christoval).—PFEIFFER, 1848, Zeitsch. für Malak., V, p. 120; 1853, Mono. Heliceorum Viven., III, p. 371; idem, 1859, IV, p. 440; idem, 1868, VII, p. 77; idem, 1877, VIII, p. 108.—PHILIPPI, 1850, Abbild. Neuer Conchylien, III, p. 98, Pl. ix [38], fig. 7.—DESHAYES [in] FERUSSAC, 1850 (?), Hist. Nat. Des Mollusques, II, p. 105, Pl. OLIV, figs. 3-4.—PFEIFFER, 1854, Conchy.-Cab., I, pt. 13, Sec. 1, p. 147, Pl. XLV, figs. 18-19.—CROSSE, 1864, Jour. de Conch.,

XII, p. 148.—BRAZIER, 1889, Jour. of Conch., VI, p. 77; idem, 1889, Proc. Zool. Soc. London, p. 162.—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 72.

Bulinus (Aspastus) miltocheilus, ALBERS, 1850, Die Heliceen, p. 149.—BRAZIER, 1895, Proc. Linn. Soc. New South Wales, (2) IX, p. 569.

Otostomus (Aspastus) miltocheilus, H. AND A. ADAMS, 1858, The Genera of Recent Moll., London, II, p. 151.—CHENT, 1859, Man. de Conch., I, p. 437, fig. 3216.

Bulinus (Placostylus) miltocheilus, SMITH, 1885, Proc. Zool. Soc. London, p. 595.—GUPPY, 1887, The Solomon Islands and Their Natives, London, I, p. 345.

Placostylus (Aspastus) miltocheilus, KOBELT, 1891, Conchy.-Cab., I, pt. 13A, p. 63, Pl. xv, figs. 2-5.—PILSBRY, 1900, Man. of Conch., (2) XIII, p. 94, Pl. xxxviii, figs. 53-54.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 413.

Placostylus miltocheilus manugensis B. RENSCH, 1934, Sitz. Gesell. Natur. Freunde, p. 453.

REMARKS.—This species appears to be one of the most abundant in the genus where it occurs. Both the Mann and Eyerdam collections contained a much larger proportion of this species than any other. It is apparently well distributed throughout San Christoval and its coastal islands.

RECORDS.—San Christoval: (Reeve; Pilsbry); Port Makera [Makra]; Wano or Wanga Bay; Recherche Bay (Brazier); Pamua; Wainoni Bay (Clapp); Kira Kira (Whitney; Paravicini; Rensch); Mts. of San Christoval at 1000-2000 feet (Whitney); Manugia (Paravicini; Rensch). Sesarga: [= Savo] (Brazier), questioned. Ugi: (Brazier; Mann; Smith).

NOTES.—Found on the leaves of trees (Brazier); arboreal, on palm trees (Mann); on bushes (Eyerdam).

The yellow shells from Ugi were described by Brazier as the variety *stramineus*.

The occurrence of this species or any of its varieties on the island of Sesarga [= Savo] is open to question.

Placostylus (Aspastus) miltocheilus *stramineus* (Brazier)

Bulinus miltocheilus var. BRAZIER, 1889, Jour. of Conch., VI, p. 77 (Ugi [Ugi] or Gulf Island).

Bulinus (Aspastus) miltocheilus var. *stramineus* BRAZIER, 1894 [1895], Proc. Linn. Soc. New South Wales, (2) IX, p. 569 (Ugi Island).

Placostylus (Aspastus) miltocheilus stramineus

PILSBRY, 1900, Man. of Conch., (2) XIII, p. 95, Pl. XXXVIII, fig. 55.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 414.

Placostylus miltocheilus paravicinii B. RENSCH, 1934, Sitz. Gesell. Natur. Freunde, p. 453 (Wai Beroni, San Christoval).—I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 73, Pl. I, fig. 4.

REMARKS.—Smaller than the typical form and not possessing such strong axial ridges. It has in addition a diffusion of a yellow pigment throughout the entire shell.

It is interesting in this connection to note the development of coloration in certain of these shells. The typical form usually, though not always, develops its color late in life, that is, at the beginning of the lip structure. At the time the lip is being produced, pigmentation starts, and in this case a deep yellow color is used. It is impregnated into the body of the calcium carbonate and as its successive layers are formed, produces a deep orange lip. The varietal form, on the other hand, develops this color while still in the egg, and owing to its dilution—i.e., to new areas of shell material, results in a yellow shell. At shell maturity it continues to lay down pigment and lime forming the orange colored lip as in the typical form.

NOTES.—Found on palm tree trunks, some 6 to 20 feet from the ground (Brazier).

RECORDS.—Bio: (Clapp). San Christoval: Wai Beroni (Paravicini; Rensch). Three Sisters: (Clapp). Ugi: (Brazier; Clapp; Paravicini; Pilsbry; Rensch).

***Placostylus (Aspastus) miltocheilus mayri*, new name**

Bulimus (Aspastus) miltocheilus minor BRAZIER, 1894 [1895], Proc. Linn. Soc. New South Wales, (2) IX, p. 570 (Ulaua or Ulawa Island), non *P. minor* Kobelt, 1891, p. 21, non *P. minor* Kobelt, 1891, p. 42.

Placostylus (Aspastus) miltocheilus minor, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 95.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 416.

Placostylus miltocheilus minor, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 74.

REMARKS.—This is a race much smaller than the typical form. In the original description given by Brazier (*loc. cit.*), he limits the color to white on the shell proper. A fairly large series obtained by Mr.

Eyderdam indicates a color range from pure white to canary yellow, similar in all respects to the typical form other than in size.

RECORDS.—Ulaua [=Ulawa]: (Brazier; Whitney; Pilsbry; Rensch).

***Placostylus (Aspastus) miltocheilus albolabris* (Brazier)**

Bulimus (Aspastus) miltocheilus var. albolabris BRAZIER, 1894 [1895], Proc. Linn. Soc. New South Wales, (2) IX, p. 570 (San Christoval and Santa Anna islands).

Placostylus (Aspastus) miltocheilus albolabris, PILSBRY, 1900, Man. of Conch., (2) XIII, p. 95, Pl. XXXVIII, fig. 32.—CLAPP, 1923, Bull. Mus. Comp. Zool., LXV, p. 415.

Placostylus miltocheilus albolabris, I. AND B. RENSCH, 1935, Revue Suisse de Zoologie, XLII, p. 74.

REMARKS.—Quite similar to the typical form but having a white instead of an orange lip. Certain shells, however, have a yellowish cast.

RECORDS.—San Christoval: (Brazier; Rensch); Bulimatarivo or Star Harbor (Clapp). Santa Anna: (Brazier; Clapp; C. M. Cooke; Eyderdam; Paravicini; Pilsbry; Rensch; F. S. Webber).

PARTULIDAE

PARTULA FÉRUSSEAC

A genus of wide distribution in the southern and western Pacific.

SUBGENUS MELANESICA PILSBRY

SYNGENOTYPE.—*Partula turneri* Pfeiffer.

All the known species but one of *Partula* occurring in the Solomons are members of this subgenus.

Very little new material from the Solomons has come to hand since the review of this family by H. A. Pilsbry (Man. of Conch., 1909, (2) XX, pp. 280–298). A single new species is added to the list, obtained on Rennell and Bellona islands, by the Whitney Expedition in 1930 and later by the Crocker Expedition. The description and a few synonymic notes follow.

Partula micans Pfeiffer

Partula micans PFEIFFER, 1854, Proc. Zool. Soc. London, 1852 [1854], p. 138 (Solomon Islands).

Partula cinerea ALBERS, 1857, Malak. Blatter, IV, p. 98.

Partula perlucens HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 31, Pl. II, fig. 2 (Ugi or Golfe Island).

I am unable to separate *cinerea* and *perlucens* from Pfeiffer's species. A fair-sized series obtained by Mann from Ugi and other small islands nearby will fit any of the descriptions equally well. The Shortland Island record of Sowerby and Fulton may be based on another species (in Pilsbry, 1909, Man. of Conch., (2) XX, p. 295).

RECORDS.—Bio: (Mann). Three Sisters: (Mann). Ugi: (Mann).

Partula incurva Hartman

Figure 11

Partula incurva HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 31, Pl. II, fig. 3 (Rubiana, Solomon Islands).

This species occurs on Rubiana as well as the main island of New Georgia. It appears to be close to *micans*, differing slightly from that species mainly in being less wide in proportion to its length.

RECORDS.—Rubiana: (Hartman; Mann; J. H. Waterhouse). New Georgia: Labete (Mann).

RENNELLIA, NEW SECTION

SECTION TYPE.—*Partula cramptoni* Clench.

Partula cramptoni, new species

Figure 13

DESCRIPTION.—Shell large, produced, rimately umbilicated and rather solid. Color, medium brown-green, the early two whorls being a dark brownish black and the body whorl deep brown just behind the lip. Whorls 5, only slightly convex. Spire extended and smoothly tapering, produced at an angle of 40°. Aperture subovate, and in profile, cast at an angle of 71° from the base line. Lip expanded, especially so at its base. Colored a deep brown on the expanded area and a short distance within. Columella thickened with the lip area expanded over the umbilical rimation. Suture well impressed but not indented. Sculpture of numerous, fine, spiral incised lines. Growth lines very fine and somewhat irregular. Early two whorls very finely rugose, the spiral lines present on all but the first whorl.

LENGTH	WIDTH	APERTURE	
26.5	14.8	11.5 × 6.5 mm.	Holotype
28.1	14.0	11.5 × 6.0	Paratype
27.3	14.5	11.0 × 6.0	"
27.5	14.5	10.0 × 5.5	"

HOLOTYPE.—A.M.N.H. No. 79014, Rennel Island, Solomon Islands, Whitney Expedition, June 1930. Paratypes in the Amer. Mus. Nat. Hist. (Whitney), the Mus. of Comp. Zool. (Whitney and Crocker Exp.), and the Bernice P. Bishop Museum (Crocker Exp.) from Rennell and Bellona islands.

REMARKS.—*P. cramptoni* is one of the most distinctive species recorded from the Solomons. It is much larger and heavier than the other species and has a very dark brown coloration which differs materially from the light yellowish of the smaller forms. We propose the name *Rennellia* as a section for this single species.

All of the specimens of this new species were collected dead, though in fair to good condition. It is quite probable that the shells are somewhat shining in live material.

As stated before, nothing can be added to the Solomon Island Partulae other than the few notes above. The following list of Partulae completes the list of known forms from these islands.

Partula alabastrina PFEIFFER, 1857, Proc. Zool. Soc. London, 1856 [1857], p. 39 (Solomon's Islands).

This species was cited in error as coming from the Solomons. It is now known to occur on Moala, Fiji Islands (Pilsbry and Cooke, 1934, Occ. Pap. B. P. Bishop Mus., X, No. 4, p. 17).

Partula cori "Angas" HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 32, Pl. II, fig. 7 (Ysabel Island, Solomon Islands).

Partula flexuosa HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 204, text figure (St. Georges and Eddystone islands, Solomon Islands).

Partula hastula HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 33, Pl. II, fig. 9 (Erromango Isl., Solomon Islands) [Erromanga]. Erromango is in the New Hebrides and not the Solomon Islands. See Pilsbry, 1909, Man. of Conch., (2) XX, p. 291.

Partula hollandiana PILSBRY, 1909, Man. of Conch., (2) XX, p. 293, Pl. XXXVII, figs. 8-10 (locality unknown).

Partula pellucida PEASE, 1871, Proc. Zool. Soc. London, p. 457 (Guadalcanar, Solomon Islands).

Partula regularis HARTMAN, 1886, Proc. Acad. Nat. Sci. Phila., p. 31, Pl. II, fig. 4 (Savu, [Savo] Galeria Island, Solomon Islands). [I am not able to determine just what Capt. Brazier (through Hartman) meant by the above locality. Savu is Savu Island, a small volcanic island a little north of the western end of Guadalcanar. Galeria probably is Galera Island, a small island

in the Buena Vista group in the Florida archipelago several miles NE. of Savo Island. Probably two localities were meant to be indicated.]

I. and B. Rensch 1935 (Revue Suisse de Zoology, XLII, p. 84) add Aola and Domma, Guadalcanar, as additional localities.

SPURIUS AND EXTRA LIMITAL PARTULAE

The following species, originally assigned to the Solomon Islands, are now known to occur elsewhere.

Partula peasei COX, 1871, Proc. Zool. Soc. London, p. 644, Pl. LII, fig. 2 (Solomon Islands).

This is *Diplomorpha peasei* (COX) which probably occurs only in the New Hebrides (cf. PILSBRY, 1900, Man. of Conch., (2) XIII, p. 117, Pl. LXXII, figs. 7-9).

Partula reeveana PFEIFFER, 1854, Proc. Zool. Soc. London [1852], p. 138 (Solomon Islands).

This is *Partula otaheitanica* (BRUG.) from Tahiti, Society Islands (PILSBRY, 1909, Man. of Conch., (2) XX, p. 184).

Partula salomonis PFEIFFER, 1854, Proc. Zool. Soc. London [1852], p. 137 (Solomon Islands).—BRAZIER, 1889, Jour. of Conch., VI, p. 79.

This species is a *Placostylus* from the New Hebrides group. (CROSSE 1864, Jour. de Conch., XIV, p. 131, as *Bulimus*) and (PILSBRY, 1900,

Man. of Conch., (2) XIII, p. 70; idem, 1909, XX, p. 320). BRAZIER (*loc. cit.*) points out that Pfeiffer redescribed this species as *Bulimus pyrostomus*, both names based upon the same material originally collected by him on the island of Aneiteum, New Hebrides.

Partula tryoni HARTMAN, 1885, Proc. Acad. Nat. Sci. Phila., p. 204, text figure (Solomon Islands).

This is *Partula zebrina* Gould from Samoa (PILSBRY, 1909, Man. of Conch., (2) XX, p. 269).

Placostylus (Leucocharis) dorseyi DALL, 1910, Field Mus. Nat. Hist. Zool., Ser. 7, No. 8, p. 219, Pl. IV, fig. 1 (Anair Island, Solomon Islands).

This species is unquestionably a *Partula* and not a *Placostylus* as recently pointed out by Haas (1939, Field Mus. Nat. Hist., XXIV, No. 8, p. 102). However, both authors are wrong in assigning Anair Island to the Solomons. It is in the Bismarck archipelago near New Ireland.

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THE FUNCTION OF SABER-LIKE CANINES IN CARNIVOROUS MAMMALS

BY GEORGE GAYLORD SIMPSON

INTRODUCTION

The development of saber-like upper canines in flesh-eating mammals has occurred independently at least three times, in the South American Pliocene marsupial *Thylacosmilus* (see Riggs, 1934), in the North American Eocene creodont *Apataelurus* (see Scott, 1938), and in the widespread Oligocene to Pleistocene machairodont cats. The machairodonts, at least, survived for millions of years and evidently found this structure eminently useful, but no living carnivore has anything of the sort. The bizarre and savage appearance of these teeth stimulates lay and scientific interest and invites speculation as to their function. The absence of any close recent analogy makes inferences difficult. It is not surprising that a large literature has grown up on the subject and that strong differences of opinion exist.

Nearly ninety years ago, Warren (1853) gave an excellent functional description of the canines and associated structures in *Smilodon*. He concluded that the canines transfix the prey and then cut and tore by movement of the head backwards. He thus foreshadowed both of the views variously emphasized by most later authors: that the canines were used for stabbing (transfixing) and for slicing (cutting and tearing). The stabbing theory was more explicitly developed by Brandes (1900), whose arguments were, however, weakened by the suggestion of adaptation for preying on glyptodonts. Of course, the fact is that the armor of the glyptodonts and the canines of the machairodonts were fully developed millions of years before these two sorts of animals ever came in contact with each other. Matthew (1901) suggested the most widely accepted theory: that the

usual prey was the thick-skinned ungulates, the action being to strike and then rip or gash so that the prey bled to death. This view was again and more fully developed in his later paper (Matthew, 1910), which is the classic and still the most useful treatment of this subject. Many later authors, for instance, Scott and Jepsen (1936), have emphasized stabbing or snake-like striking as the only or at least the most important function.

The most recent study is that of Bohlin (1940) who rejects the stabbing theory entirely and maintains that the sabers were ill-adapted for this function and must have served mainly or wholly for slicing. He concludes that the machairodonts were not prelaceous but were primarily carrion-feeders, an idea previously suggested by Weber (1904), Marinelli (1938), and a few others, although the great majority of students have believed that all these saber-toothed flesh-eaters were eminently predatory.

Bohlin's study is so able and reasonable, despite its unusual conclusion, that it seemed at first reading to be definitive and to require radical revision of current ideas of sabertooth habits and history. It was, however, then noticed that certain of the arguments advanced by Bohlin as conclusively opposed to the stabbing theory apply with equal force to many of the front-fanged venomous snakes and could be used to "prove" that they cannot strike a stabbing blow or that their fangs are not adapted to this function, which is absurd. Evidently there is a fallacy either in Bohlin's arguments or in the analogy with these snakes, and reconsideration is necessary.

The snake analogy is imperfect and must

be carefully limited. The primary purpose of insertion of venomous snake fangs is different from that of the mammalian sabers, which certainly did not inject poison. The associated musculature and osteology are also very different in snakes. Some snakes do, however, insert the fangs by an efficient stabbing action and these fangs are usually, if not always, definitely more curved than they should be if Bohlin's argument is correct, and they are frequently inserted at a "wrong" angle. To this extent the analogy is valid. Relatively little detailed study seems to have been made of the exact motion of snake fangs in penetrating the prey. The best that I have seen (kindly brought to my attention by C. M. Bogert) is by Klauber (1939) and refers to rattlesnakes, the fangs of which are less analogous to mammalian saberteeth than are those of some of the other pit-vipers (e.g., *Bothrops*) and many of the elapids. Consideration of all these reptiles yields a vital clue: the fangs are driven in with a rotary movement and the mechanical center of this rotation does not necessarily or usually coincide with an anatomical joint.

Experiments were made with the skulls (originals or casts) of numerous machairodont cats and of *Thylacosmilus*. (The skull and sabers are unknown in *Apataelurus* although the presence of the latter is certain from the structure of the lower jaw.) These were supplemented by the manipulation of cut-outs and the study of successive tracings made as these were moved in various ways. The general anatomy of *Smilodon* (see especially Merriam and Stock, 1932) was also considered, along with the special features of musculature distinguishing it from the felines (especially Matthew, 1910, and Marinelli, 1938). Some of the results of this study are summarized in the following paragraphs.

Fundamental considerations are the mechanical nature of the canine and the points most conveniently used to represent and analyze motion of the head, in which the canines are immovably fixed. The axis of the canine may be taken as a curved, longitudinal line approximately in the center transversely (labiolingually) and at or near the part of the tooth that is thickest

transversely. This thickest part is seldom at the center of the tooth anteroposteriorly but usually more anterior. In *Thylacosmilus* it is marked by a definite ridge, on the labial side, but in the machairodonts the lingual and labial canine surfaces are smoothly curved. In most cases it is noticeable that this axis is more nearly parallel to the anterior than to the posterior margins of the tooth, especially in the more proximal part. The posterior margin is invariably formed by a more acute angle than the anterior and it bears a sharp cutting edge nearly or quite to the alveolus. Although more obtuse, the anterior margin is also always trenchant at least in its distal portion. A variable extent of the proximal part of this margin is usually rounded and not trenchant.

The points used to analyze head motion are (a) the tip of the canine, which leads the work, (b) the occipital condyles (or the projection of a transverse axis approximately through their centers), which are the mechanical fulcrum nearest to the canines and the point of application of motion from neck and body, (c) the approximate center of gravity, the motion of which is related to the general direction of momentum, and (d) the center of rotation. In distinction from Bohlin's analysis, it is again emphasized that the center of rotation is not necessarily a mechanical fulcrum or anatomical joint. It is an imaginary point helping to visualize and analyze complex motion derived from the joint action of a whole series of real fulcrums no one of which is likely to be quite stationary: all the joints of the axial skeleton, especially those of the neck, and also to some extent all the limb joints, especially those of the fore-limb. The center of rotation may be at almost any point within or outside of the animal.

Circumlocution can be avoided by a few simple definitions for present purposes. A pure stabbing motion means a stroke in and then out with a minimum of cutting consistent with the form of the weapon. Cutting is used in the ordinary sense, but for distinction the word slicing is used to mean cutting not necessary merely to insert and withdraw the weapon. Down-

slicing is such extra cutting performed during the insertion of the weapon and up-slicing during its withdrawal. Straight-

slicing is performed with the weapon remaining at approximately the same depth in the wound.

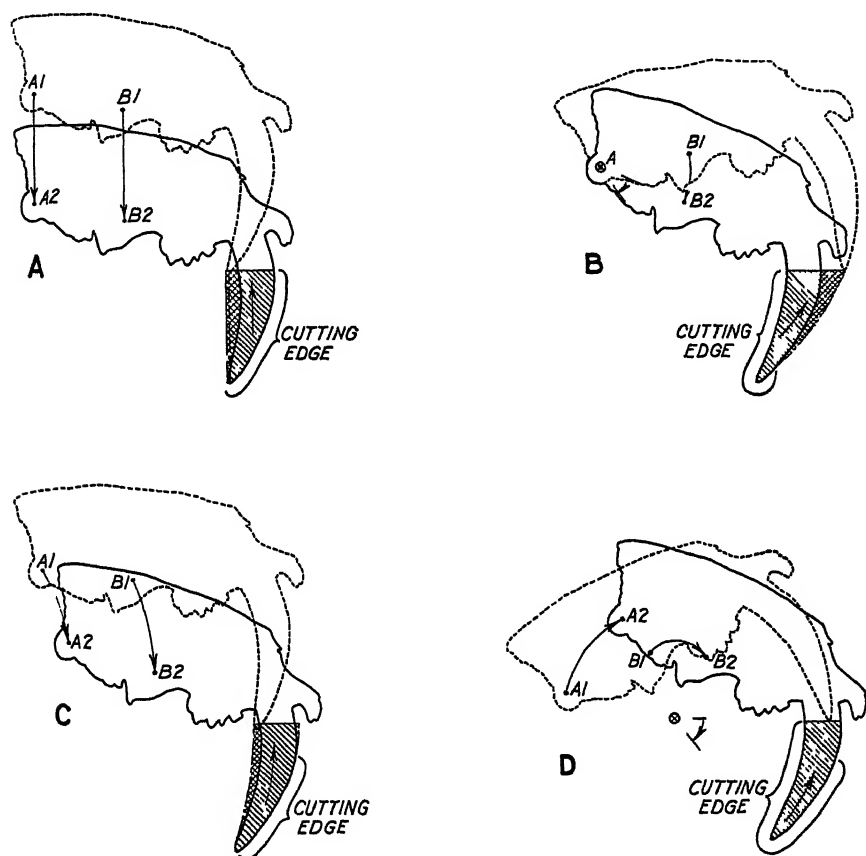


Fig. 1. Diagram of possible methods of stabbing in *Smilodon*. A, motion straight downward. B, rotation of skull on the condyles. C, rotation on the cervico-dorsal joint. D, rotation around the center of curvature of the canine axis. In all figures, two phases are shown, 1 at the beginning of insertion of the canines, and 2 at its completion. The skull is shown in broken outline in phase 1 and solid outline in phase 2. A is the condylar center of rotation and B the approximate center of gravity, and the affixed numbers show the positions of these points in each of the two phases. The circle and cross in B and D are centers of rotation. The arrow on the canine is the approximate direction of greatest strain. The simply cross-ruled area is the cutting necessary for insertion of the canine and double cross-hatching represents slicing, unnecessary for such insertion.

STABBING

The simplest stabbing motion would be straight down, Fig. 1A. This involves considerable slicing, which represents a loss of effort in pure stabbing; it puts great oblique strain on the delicate tip of the tooth; and it uses almost the whole of the

anterior edge and none of the posterior edge for cutting. It is obvious that the posterior edge is the more efficient for cutting and that the proximal part of the anterior edge is often incapable of cutting. It seems quite impossible that the animals

habitually stabbed in this way (which would, moreover, be a difficult motion to impart to the head with any force).

Rotation about the condyles, Fig. 1B, also involves some (but less) slicing. The stress is somewhat oblique, although probably not enough to cause unbearable strain. Cutting is mostly on the posterior edge, as it should be, with a little on the distal end of the anterior edge, which is also morphologically justified. Such stabbing was entirely possible, but Bohlin is clearly right in concluding that the anatomical structure is not perfectly adapted to it. Aside from the probably insignificant loss of cutting efficiency, the principal disadvantage is that power is derived only from the muscles depressing the head on the atlantal joint. These are powerful, but the loss of any help or momentum from post-cranial movement would be inefficient. It is incredible that the animals should have tended to hold the atlas quite motionless while moving the head violently.

Bohlin believes that stabbing motion would really be by rotation on the cervico-dorsal joint (Fig. 1C), and he concludes that the canines are ill-adapted for stabbing by such a motion. A small amount of slicing is involved. The stress on the tip is oblique, but only slightly and probably not dangerously. The serious disadvantages are that cutting is entirely on the anterior edge of the canine, and that little or no action by the head-depressing muscles is involved, although these are known to have been unusually powerful and can only be inferred to have been hypertrophied by functional relationship to the canines. I emphatically agree with Bohlin that the sabertooths did not habitually stab in this way, while disagreeing just as emphatically with his conclusion that they therefore did not stab at all.

Rotation about the center of a circle of which the axis of the canine is an arc, Fig. 1D, imparts a perfectly efficient pure stabbing motion to the canines. There is no slicing and the cutting incidental to pure stabbing uses the whole of the posterior and about two-thirds of the anterior edge of the canine. The proportion of the anterior edge involved in cutting with this motion

varies according to the shape of the tooth. In *Thylacosmilus*, for instance, only a small distal part of this edge would need to cut, while in some machairodonts almost the whole edge would be involved. It is not likely to be a coincidence that in each case the part of the anterior edge that must cut for greatest efficiency with this motion does in fact have a cutting edge while the more proximal, theoretically non-cutting part does not.

The relation of this motion to the musculature is also advantageous. The motion would result from a thrust of the head forward and its simultaneous depression. Although the occiput tends to rise somewhat, no lifting muscular effort is involved; this is a mechanical result of forward thrust against the occiput accompanied by strong depression of the head on the occipito-cervical joint. A forward lunge is the universal motion of attack, and one of which the sabertooths were certainly well capable. The depression of the head on its fulcrum is, as already noted, provided for by unusually strong muscular development in just these animals. Bohlin adduces as evidence against stabbing that the attacking sabertooth would have to come to a full stop before stabbing and then start a new motion at right angles to the momentum of attack. On the contrary, my analysis seems to show that the attack and the stab would follow naturally and that much of the attacking momentum would be utilized in driving in the sabers. Instead of being less, this seems to me a mode of attack decidedly more efficient than in the "normal" (non-sabertooth) carnivores, in which the forward momentum helps little or not at all to drive in the teeth.

Merriam and Stock (1932, p. 46) state that the canine curvature in *Smilodon* makes it "probable that the downward stroke of the tooth must have been accompanied by a backward jerk in order to make it fully effective." If by "backward jerk" a rotation of the head downward on the occipital condyles is meant, this agrees with the result reached in this paper, but it is to be emphasized that backward motion transmitted to the head from the neck would result mainly in slicing, as discussed

later. Merriam and Stock agree that these teeth are chiefly stabbing weapons, and pure stabbing demands that the motion transmitted to the head should not be backward.

This mode of stabbing theoretically requires that the center of the curvature of

have investigated, including several genera of machairodontines and the quite independently evolved sabertooth marsupial *Thylacosmilus*, this point is indeed in the region so delimited (Fig. 2). Within this region its exact position varies considerably, even by individual variation within

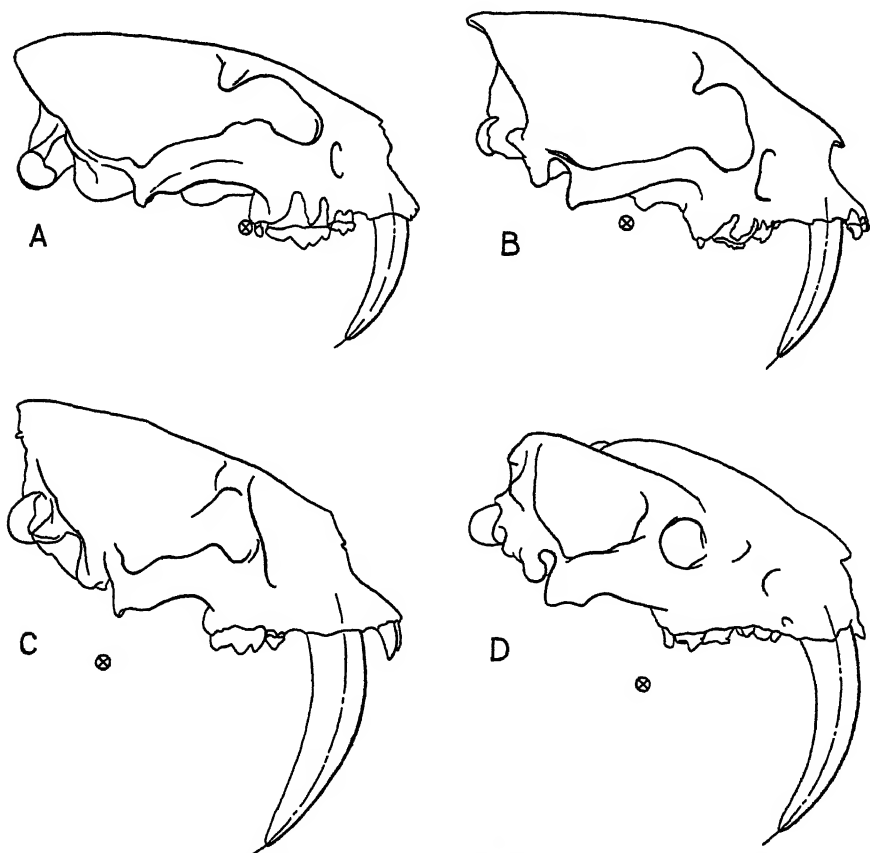


Fig. 2. Skulls of sabertoothed mammals, showing axes of the canines and the centers of curvature of these axes. A, *Machairodus*. B, *Hoplophoneus*. C, *Smilodon*. D, *Thylacosmilus*. Base for A from Filhol, for B from Matthew, for C from Merriam and Stock, and for D from Riggs. Not to scale.

the canine axis should be well above the canine tip (when the skull is oriented with the palate approximately horizontal), at or a short distance below the alveolar level, below and anterior to the condyles, and posterior to the canines by about half the distance to the occiput or somewhat more. In all the sabertoothed animals that I

one species. It is often modified by post-mortem crushing, and it may also be subject to progressive phylogenetic adaptation—a point worthy of more detailed investigation. (Klauber finds that the fang curvature is a taxonomic character in snakes.) Canines with the center of curvature well posterior to the head, which Bohlin con-

siders theoretically necessary for efficient stabbing, would give little use to the head-depressers which are apparently the most important head muscles in all these animals. It thus seems that less curved canines would really be much less efficient stabbers than the canines that really occur. It is also significant that venomous snake fangs, which certainly are efficient stabbing weapons and the mechanics of which are analogous to those of sabertooths without being

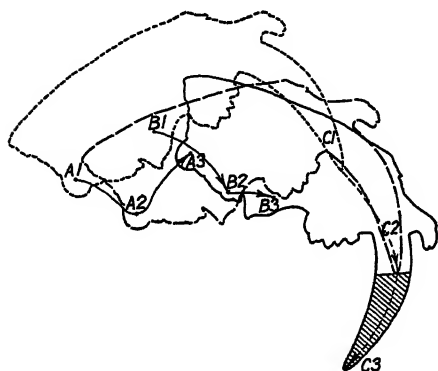


Fig. 3. Diagram of last phases of attack by *Smilodon*. Phase 1, approach, with skull in dotted outline; 2, beginning of stab, broken outline; 3, end of stab, solid outline. A, center of condyle. B, approximate center of gravity. C, end of canine. Ruled area is that cut by penetration of canine.

exactly the same, have the center of curvature in a region mechanically analogous to that found in these mammals.

In short, I believe that stabbing in this way is the action for which the whole sabertooth structure is most efficiently adapted. Doubtless the completely perfect stab of

the diagram was as rare as perfection always is in nature, but this seems to be the true norm and the adaptive goal of this type of structure.

The more extended final phases of such an idealized normal attack, subject to the myriad deviations of circumstances, are diagrammatically represented in Fig. 3. Here motion from 1 to 2 is the final phase of approach in the attack and phase 2-3 the stabbing thrust of the canines. In phase 1-2 the body is moving forward, the neck and head whipping downward and forward. The head is rotating slowly but with increasing acceleration. At 2 the canines hit the prey and a pivoting motion begins—the sudden encountering of resistance on this fulcrum would itself tend to initiate and to assist the pivoting (as would also the contact of the open lower jaw). Forward and downward motion of the head as a whole continues, modified by the still greater acceleration and snapping contraction of the head-depressers as the canines are driven in along their axes. The head might be said to rock forward on the canines, and so transmits in this new direction the greater part of the momentum of the approach.

As far as I know, the only direct evidence of use of a canine saber is that described by Scott and Jepsen (1936, p. 148), a skull of *Nimravus* with a wound exactly such as would be produced by pure stabbing motion by the associated sabertooth *Eusmilus*. One example does not necessarily indicate a habit, but it does prove a possibility. Incidentally this wound was inflicted on a living animal and not on carrion, a point to be discussed later.

SLICING

Consideration should also be given to the possibility of purposeful slicing, as opposed to slicing incidental to deviations from perfect stabbing. Most adherents of the stabbing theory have considered slicing as a probable accompaniment or secondary function. Bohlin considers it the primary function. In the first place, slicing without stabbing seems unlikely. The canines cannot slice unless they are inserted in the

hide or flesh, and the easy way to get them in would be by stabbing, whether in its pure attack form or in some modified manner.

Straight slicing considered as an activity independent of stabbing is diagrammatically shown in Fig. 4A. Personal experience of the practical impossibility of cutting tender meat with a sharp knife without hacking or sawing motion is suggestive of the tremendous effort necessary for a

sabertooth to slice tough hide and muscle in this way with its duller weapon. In view of the very oblique strain involved, it is doubtful whether the teeth could stand continual application of this great force even if the animal could exert it.

(Fig. 4B), up-slicing (Fig. 4C), or both (Fig. 4D). In all three figures the amount of slicing is roughly the same. In down-slicing the head is jerked backward while being rotated (or depressed) about a center near or above the top of the posterior part

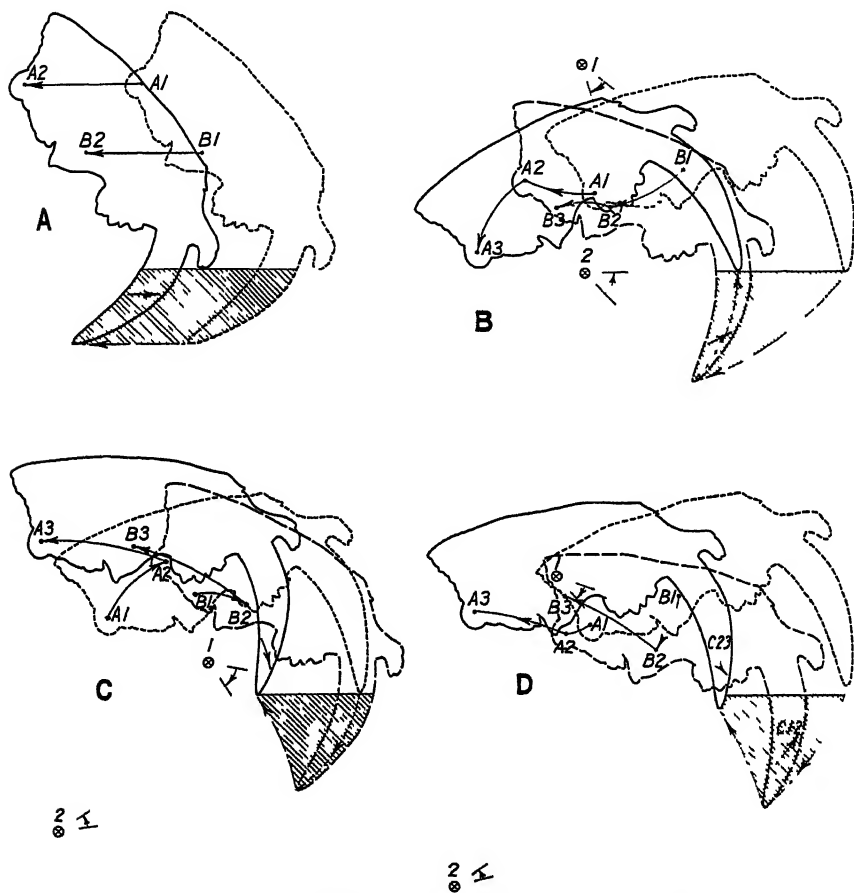


Fig. 4. Diagrams of slicing in *Smilodon*. A, straight slicing. B, down-slicing. C, up-slicing. D, down-and-up-slicing. Symbolism and construction of diagrams as in Figs. 1 and 3, except that whole cut is shown as a unit without distinction of slicing from cutting necessary for insertion of canine. The arrows on the canines represent approximate direction of greatest stress in the phase immediately preceding the given position of the canine.

It seems probable that a sabertooth with the desire or necessity of slicing with the sabers would adopt the expedient of hacking, that is, of combining stabbing and slicing (a straight chopping motion against the edge being out of the question). Such stab-slicing could involve down-slicing

of the skull. The saber is then withdrawn without cutting by rotation in the opposite direction around the center of curvature of the canine. The oblique strain, especially on the tip of the canine near the beginning of the cut, would be great. If a slice of any considerable extent were made at one stroke

the direction of motion would tend to be nearly at right angles to the cutting edge, minimizing shearing or sawing action and making the cutting very difficult.

In up-slicing the canine is first stabbed in by pure stabbing without slicing and is then withdrawn by pulling the head backward and upward, or with rotation about a point below and behind the center of canine curvature. (In such a case a diagram showing rotation on a fixed point is doubtless over-simplified; the center of rotation probably moved and the true course might be more nearly a section of a spiral than an arc of a circle.) This would probably require somewhat less effort than down-slicing, because the difficult insertion is accomplished in the easiest possible way and the cutting could largely be performed by rocking backward on the fore-limbs against the gradually decreasing pull of the head-depressers. The effort would nevertheless be great and a long slice would require almost prohibitive exertion and transverse strain on the tip of the canine.

A down-and-up slice can be accomplished by relatively straight backward motion at the condyle, accompanied by depression and raising of the head, mechanically equivalent approximately to rotation first about a point near the posterodorsal end of the skull and then rotation in an opposite direction about a point below the posterior end of the skull. This second rotation would follow almost automatically from the backward pull against the cutting resistance. Such motion is smoother and easier than either pure down- or up-slicing, and it seems psychologically and physically a more natural motion for an animal to make. For a given size of slice, its efficiency would also be greater because the angle of the cutting edge to its work would be more acute, increasing the relatively easy sawing or shearing component, and its safety would be greater because less (although still considerable) strain would be put on the tip of the tooth. On the whole it seems probable that if the animal did intentionally slice, it would tend to do so in this way.

The result of such an action is somewhat like that of a stab that is unnecessarily

broad. As typically developed, however, the down-and-up slice is unlike the pure stab. In the former the neck or body motion is backward, in the latter predominantly forward. One would be used more on disabled or dead prey, the other more in attack on active prey. A sabertooth in action would not be concerned with following diagrams or maintaining maximum efficiency, and undoubtedly would use all sorts of variant and intermediate motions, but pure stabbing and down-and-up slicing seem to be the norms of the two most likely uses of the canines.

Another factor to be considered is the possible effect of preponderance of strain at the alveolus in any one direction other than along the tooth axis. It is well known that such pressure has a tendency to make the alveolus move. Thus under normal conditions the alveolar, and hence also the coronal, orientation may often be inferred to be one such that the tooth axis represents the average direction of pressure. In any sort of stabbing except that shown in Fig. 1D, the average pressure is not along the tooth axis. Pure stabbing as in Fig. 1D is the only likely action that centers strain in the direction of that axis, and therefore is probably the normal use correlated with the observed orientation. Any probable sort of slicing is almost certain to produce a pressure component tending to rotate the crown forward about the alveolar mouth as a fulcrum or to move the alveolus itself forward. For a given amount of slashing, this component would probably be weakest or least constant in down-and-up slicing as in Fig. 4D. It is improbable that the observed orientation was developed in relation to slicing of any sort as the predominant use of the teeth, although probable that a moderate amount of slicing as a secondary activity would not seriously disturb the orientation correlated with stabbing. Other factors enter into the situation (such as a growth or other tissue pressure counteracting the pressure of use) and some animals do habitually use teeth with pressure oblique to their axis and predominantly in one direction. The argument cannot, in itself, be considered conclusive, but it is at least suggestive.

GENERAL HABITUS

If it be granted that sabertooths could and sometimes did slash as well as stab, the question remains whether the sabers are primarily an adaptation to one or to the other. It may be misleading to speak of primary or principal adaptation to one function among several. An organ that is used in more than one way has a function that is multiple but that it fulfills as a unit. Nevertheless one use or function may fairly be called principal and primary if it had greater selective value or in any other way was more particularly concerned with the radical structural divergence of one group from another, in this case of the sabertooth from the "normal" flesh-eaters, the machairodontines from the felines or the thylacosmilines from the borhyaenines.

Fully developed or pure slicing with sabers would, as Bohlin concludes, be useful principally for dismembering dead prey or carrion. Now such slashing does not seem to me to be an advantageous way of accomplishing this end. Lions, hyaenas, and other carnivores with "normal" canines certainly accomplish this work adequately for their own needs, using the carnassials for slicing and the canines and incisors for holding and tearing. Indeed if there is any selective value in this function, it may well favor "normal" canines—possibly this is a factor in the development of feline canines if, as Matthew believed on the basis of strong evidence, they evolved from canines intermediate between the specialized feline and machairodontine types. The considerations already expressed suggest that the sabers are not really well adapted to tearing out long strips of flesh, the one way in which some real advantage over the felines in slicing seems possible. It would beg the question to say that the ability to pierce thicker skin on carrion was the fundamental difference, because the more efficient way to pierce such skin, whether on a live or a dead animal, is by stabbing, not slicing.

The one thing that a saber can do efficiently, for which it surely serves well and for which no part of the feline dentition serves well or at all, is stabbing. I therefore conclude that stabbing was in some sense, not necessarily causative, primarily

correlated with the differentiation of the saber canines from "normal" canines and therefore that it is the principal functional element in the sabertooth specialization. If, as they undoubtedly did, the sabertoothed mammals also used the sabers to some extent for slashing and dismembering the prey, this was because they had sabers and necessarily used them as best they could, not because the sabers are the best way to serve this need and were developed in relation with it.

A few additional objections to the stabbing theory may be more briefly considered. A few students, especially Abel (e.g., 1939 and several earlier comments), deny that the mouth could be opened wide enough to stab in this way. Among others, Matthew (1910) and Bohlin (1940) have sufficiently exposed the complete fallacy of this objection. Perhaps a conclusive point is that if the argument were logically applied to some sabertoothed animals other than *Smilodon*, it would lead to the conclusion that they could not have fed themselves at all.

In the diagrams of this paper the lower jaw is omitted for clarity, but similar experiments were made with the jaw included and it was found that the activities here considered normal for sabertooths were not impeded and may well have been assisted by the mandible. (Klauber shows that the mandible assists in insertion of rattlesnake fangs, and analogous action is quite possible in sabertoothed mammals.)

Bohlin's objection that a sabertooth must have performed the difficult action of attaching itself to its live prey before stabbing depends largely on what I believe to be his mistaken view as to the motions involved in stabbing. The animal did not have to come to a full stop before it started the stabbing motion. On the contrary, forward attack was a useful preliminary phase of stabbing and contact with the animal coincided with the strongest stabbing momentum. If attachment were subsequently needed, the insertion of the teeth is itself an attachment: dogs normally and cats frequently hold their prey in this way. It is also incredible to me that machairodonts could not cling to the back of an animal with their powerful limbs and pre-

hensile claws as do lions. Schaub (1925), especially, has concluded that machairodont fore-limbs were even better adapted for grasping prey than are those of felines.

Bohlin's further comment on the relatively weak hind-limbs relates more to the question of predaceous as against carrion-eating habits, but here, too, the conclusion does not necessarily follow. Machairodontine hind-limbs are very powerful: the misconception that they are weak arises from the relatively still greater development of the enormously strong front limbs. Merriam and Stock (1932, p. 25) point out that in *Smilodon* the hind-limbs are comparable in size (and also in strength) to those of the large living felines and, far from supposing that leaping was unlikely, these best informed of authorities on smilodont anatomy conclude that there are special adaptations for leaping or lunging at prey. Among the older machairodontines such as *Hoplophoneus*, it is also noticeable that the hind-limbs are as strong as those of comparable felines but that the fore-limbs are stronger. Although not adapted for swift running, the machairodont limbs seem fully consistent with hunting by stalking and ambush followed by a short, leaping or lunging attack perhaps balanced and powered in considerable degree by the front legs.

These front legs would themselves be powerful weapons and they could have served—as sometimes do the weaker front limbs of lions—to deliver the coup de grace to an animal slowed or stopped by the canine stab. Thus the unusually powerful fore-limbs and the unusually long canines might possibly be considered as coordinated parts of a dual apparatus for killing prey.

Among living mammals, the closest analogy to the carnivore sabers is found among the hornless ruminants, *Moschus*, *Tragulus*, and their allies. With these can be associated some extinct forms like *Blastomeryx* and related genera. I have not found a detailed description of the exact mode of use of the tusks in the living forms, although several authors speak of the males as hacking or striking downward with the head. The canines do not reach the enormous proportions of the carnivore sabers, nor

do they entirely prevent biting action. The great specialization of neck and jaw muscles and of the jaw articulation seen in the sabertooth carnivores is lacking in these ruminants. The tusks are curved and in some if not all cases the center of curvature is in about the same region as in the carnivores and does not coincide with a joint. For what the analogy is worth, the most important point is that these most nearly analogous weapons of still living animals are used entirely for offensive attack. The purpose of disabling or killing is the same whether in order to eliminate a sexual rival or to obtain food. The ruminant canines obviously were not evolved in relation to tearing strips of flesh from carrion.

Another possible analogy is provided by the extinct uinatheres, but its value is lessened by the fact that the use of the canines in these animals is itself only an inference, based largely on the living tusked ruminants, which are more like the uinatheres in this respect than are the sabertoothed carnivores. The canine curvature is highly variable but tends to follow the principles already sketched and the action seems to have been a downward hook or stab. Here, again, the purpose was surely offensive attack on living rivals.

The tusks of swine and of some extinct forms like the astrapotheres are so unlike the sabers here under discussion as to provide little basis for inference. The only point worth mentioning is that in addition to rooting for food (an action for which the sabers certainly were not used), the tusks of swine are used offensively and that the action is to impale the enemy by a rotary movement more or less along the axis of the tooth—necessarily a very different motion from that of the sabertooths, but impaling has some slight analogy with stabbing. Other animals with enlarged anterior teeth, like the proboscideans and the rodents, are too dissimilar to provide any useful comparison.

The snake analogy, already briefly considered in the extent that seems valid, involves the mechanics of tooth insertion and cannot well be extended to inferences as to general habitus. The snake fangs are obviously adapted for attack on living ani-

mals, but the fangs as such do little injury and the vital point of the attack is the injection of venom. The predaceous habits of snakes therefore do not particularly reinforce the inference that sabertoothed carnivores were predaceous.

One difficulty in the stabbing-predator theory is that it must frequently have happened that the canines failed to pierce a vital spot and that bleeding, as suggested especially by Matthew, might be slow to disable a large animal. This difficulty does not exclude predaceous habits, which do not require that all attacks result in immediate death of the prey, and it is largely removed if the fore-limbs were used as a second weapon.

Few carnivores refuse carrion and the question again is whether this action was primary or secondary as regards the sabertooth specialization. The evidence seems to me decidedly to favor the usual view that these animals were primarily predators. Bohlin's suggestion that animals with broken sabers came to depend on carrion seems very probable, but it is beside the point in considering the functions of the canines when these were present.

A final objection, also by Bohlin, is that the presence of two canines, rather than one, more than doubled the difficulty of stabbing. It must be remembered that snakes strike very successfully with two fangs. It would be genetically improbable that one canine, alone, could develop as a saber, since it appears to be the rule (with sundry exceptions) that symmetrical structures are governed by one set of genes, not by two independent sets. The develop-

ment of a single saber would also require very complex compensatory adjustments throughout head and neck. If the presence of two sabers were less advantageous than one, the question would be whether this disadvantage outweighed the selection value of stabbing. It is reasonable to suppose that it did not. Nor is it clear that the presence of two sabers was really disadvantageous. They inflict twice as severe a wound, cause twice as much bleeding, and have twice as much chance of finding a vital spot. The strength to drive two sabers into the prey certainly was present. On the other hand, slicing requires more effort than stabbing and objections that two canines are disadvantageous might apply with still greater force to the slicing theory. It is, indeed, possible that slicing would involve less danger of snagging the canines or breaking one against a bone. As regards breakage by stabbing, the presence of two canines is advantageous because it cuts in half the chances of total loss of these weapons—note, among others, the South American *Smilodon* in the American Museum that continued the use of one saber after the other was lost. The further precaution of continuous replacement, as in snakes, would have been still more advantageous, but the materials for evolution in this direction were probably lacking: mutations in the direction of polyphyodontism seem to be extremely rare in mammals. The sabertooths did have well-developed and long-functioning deciduous canines, which is about as far in this direction as a mammal is likely to be able to go.

SUMMARY

1.—The sabertooth specialization has arisen independently at least three times among carnivorous mammals. Conflicting theories are that they were used for stabbing, for slicing, or for both, and that they were related to predaceous or to carrion-eating habits.

2.—Stabbing with a curved tooth involves rotary motion, the center of which is not normally at an anatomical joint. Contrary to the most recent study, that of Bohlin, the mammalian sabertooth and the associated osteological and myological specializations are perfectly adapted for stabbing.

3.—The known saber-like canines are ill-adapted for slicing, but doubtless could be and were used to make a short stabbing slice or gash. This function is considered secondary and the stabbing attack primary.

4.—This primary adaptation of the canines and the general bodily structure are more consistent with predaceous habits than with carrion-eating. The various objections to the predaceous-stabbing theory seem all to be based on misapprehensions or to permit equally logical alternative deductions.

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DISCOVERY OF JAGUAR BONES AND FOOTPRINTS IN A CAVE IN TENNESSEE

BY GEORGE GAYLORD SIMPSON

The remarkable discoveries here recorded were made in the Craighead Caverns, about 5 1/2 miles southeast of the town of Sweetwater in Monroe County, eastern Tennessee. This cave, much the largest in this region, has been known for many years. Indian relics have been found near the entrance and the Indians certainly knew the cave and used it at least occasionally for shelter, but there is no evidence that they explored it extensively. The name Craighead is said to be that of a former owner, a Cherokee Indian. Saltpeter was mined here, as in many southern caves, to make gunpowder during the Civil War. The main rooms have been open to the public for some fifty years or more and the cave enjoys increasing fame as a tourist attraction. Cock fights and dances were formerly held in one of the rooms near the entrance, now used for mushroom growing. In spite of all this, parts of the cave were discovered only recently and some parts are still unexplored.

The discoveries to be discussed in this paper were made in 1939 and 1940 by two young men employed at the caverns, Jack Kyker and Clarence Hicks. Living in the vicinity and inveterate cave-crawlers, familiar with this cave from boyhood, they devoted their spare time to searching for new rooms and in the course of this pursuit they found some bones in a narrow fissure of extremely difficult access. In another part of

the cave, almost equally inaccessible at that time, they found footprints of some large animal.

These discoveries were brought to the attention of the present owners of the cave, Dr. W. J. Cameron and Mr. W. E. Michael of Sweetwater, who recognized their importance, investigated the occurrence, and removed some of the bones. They brought the latter to the American Museum for identification and Dr. Walter Granger and I found that the bones included parts of a very large jaguar and of an elk (or wapiti) fawn. In May, 1940, I visited Sweetwater and through the hospitality and cooperation of Dr. Cameron and Mr. Michael I was able to examine the sites and to obtain further remains of the big jaguar as well as a plaster mold of the footprints. These specimens, as well as those first found and some recovered at later dates, were generously presented to the Museum by Dr. Cameron and Mr. Michael.

I am also indebted to Dr. Berlen C. Moneymaker for a copy of his plane-table map of Craighead Caverns as known in 1929, here published with additions by Mr. Michael to show some of the later discoveries and the jaguar localities. Dr. Raymond Ditmars and his assistants at the New York Zoological Society permitted and assisted the obtaining of tracks of a living jaguar for comparison.

OCCURRENCE OF BONES

The Craighead Caverns are a large solution cave, in one of a series of knobs formed by outcrops of Paleozoic limestone. As shown in the accompanying map, the cave consists of an irregular series of large rooms, the lowest of which extends below ground-water level and contains a navigable under-

ground lake. (Through fluctuations in water level the entrance to the lake room was formerly completely under water and its discovery is recent.) The outside entrance to the cave is about 1100 to 1200 feet above sea level. The passages between the rooms are narrow in some cases

and in others are low and nearly or quite filled by fine red silt, so that some of the rooms remained unknown or unexplored until recently. There are also numerous fissures through which a man can barely or cannot squeeze. One of these, barely wide enough for a man and for the most part so low as to require crawling on face and abdomen, leaves the main cave at the point marked "C" on the map and winds for perhaps 300 feet to a point below "B" on the map, following approximately the dotted line. The passage here communicates with a vertical fissure (not shown on the map) of considerable height and depth but still very narrow, developed more or less along the northeast-southwest joint system that can be detected from the orientation of several of the cave's rooms and fissures. The small room shown at and below and to the left of "B" on the map is above this fissure, with which it communicates by a small hole in the floor.

The bottom of this fissure is filled with red cave earth and the first bones found were partly buried in and partly protruding from this earth at the lowest point in the floor of the fissure. These include a jaguar lower jaw and some twenty-five or thirty fragments apparently all of a single animal, a very young, probably newborn elk (or wapiti) fawn. This point is approximately 225 feet lower than the present entrance to the cave and about 250 feet below the old entrance shown on the map, now closed by fallen rock. It is only about 200 feet horizontally from the present entrance and about 250 from the old entrance, although by the shortest known passages it is at least 400 feet from the former and 650 from the latter.

To the left of this point (by the orientation of the map) the floor of the fissure rises rapidly and it becomes small and irregular, finally so small that we could find no further way by which a man or a jaguar could possibly continue along it. The impracticable opening above this probably communicates with the sloping room leading to

the old entrance, to the left of the new entrance, although we could not certainly prove this. At the highest accessible point, about fifty feet above the first discovery, in a deposit of very wet red clay part of the skull of a jaguar was found.

From these relationships, it would be just possible that the remains were washed down from the passage leading to the old entrance, or even from outside the cave through that entrance, but this seems unlikely. It is possible that the jaguar or jaguars wandered alive into the small room above the fissure, fell into the latter through the hole in the floor of the room, and were unable to get out. In this case the individual represented by the skull must have been trying to climb out and have become wedged or died of starvation at the highest point that it could reach. The fawn may similarly have wandered in and fallen or, more likely, may have been dragged into the cave by a jaguar. Its bones were broken when found and may have been broken by a jaguar, but this is uncertain. Some of the jaguar bones were gnawed by rodents after death.

On the wall of the fissure, within reach of the bottom, there are several parallel grooves, now lightly coated with travertine. The discoverers believed that these were claw-marks made by the jaguar in its endeavors to escape, a distinct possibility but one that I see no way of proving or disproving.

Although there is no duplication of parts and both are surely of the same kind of animal, the remains may represent two individual jaguars, since the skull appears to be of a somewhat younger individual than the lower jaw and not to articulate well with the latter. These bones will be figured and described in a following paper in which the occurrences and classification of all the larger Pleistocene felines of North America will be discussed. The elk bones evidently represent a single individual and do not appear to differ significantly from recent *Cervus canadensis*.

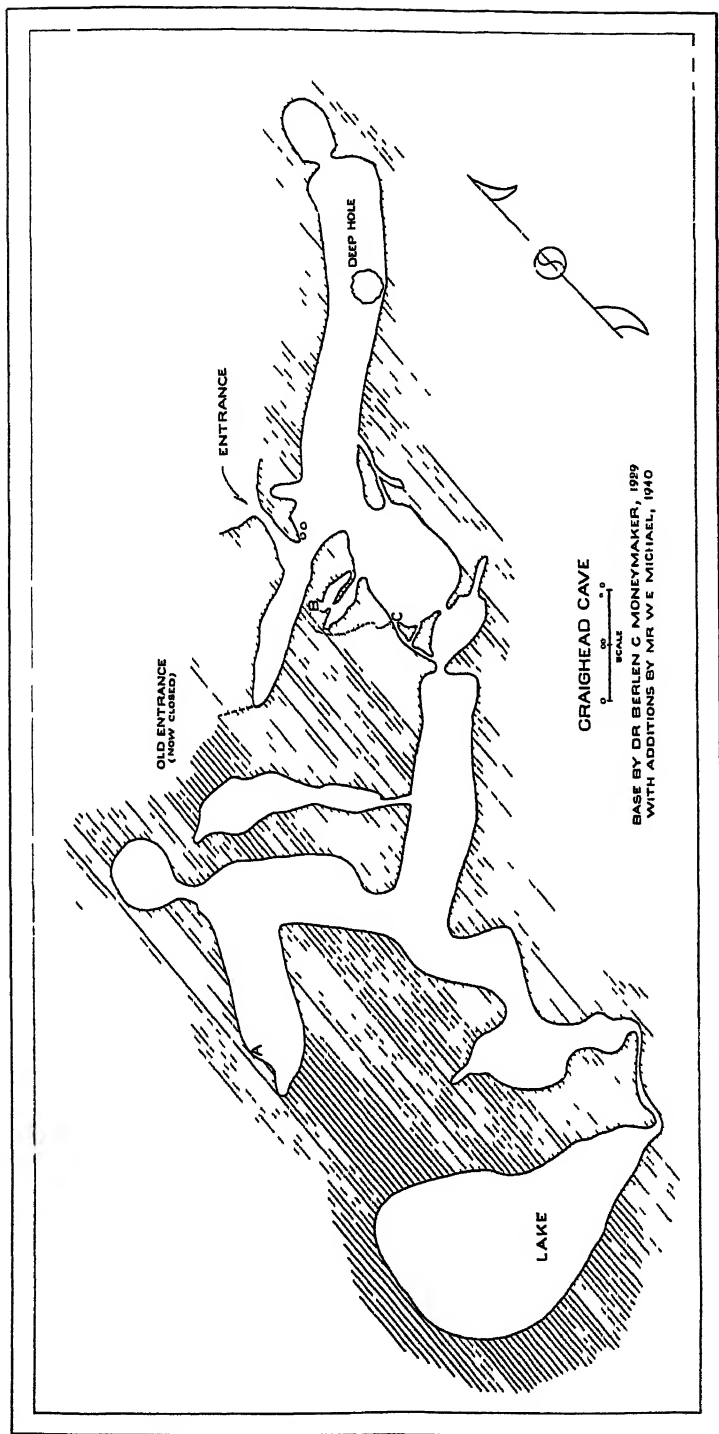


Fig. 1. Map of Craighead Caverns. A, approximate location of jaguar footprints B, point above the first bone locality. C, entrance to winding passage to bone locality.

OCCURRENCE OF FOOTPRINTS

Besides the scratches on the wall near the bones, there are numerous other scratches in various parts of the cave. Some of these appear to have been made by claws and it is possible that a few of the larger ones were made by the jaguar, but this is not subject to proof. Such single scratch markings in the parts of the cave long explored and open to the public must in any case be subject to doubt. Two clear footprints were, however, found in such a position and of such a nature that they surely represent an animal and probably the jaguar. These occurred in a different part of the cave from the bones, at the point marked "A" on the map, some 800 feet distant in a straight line horizontally and about 1500 feet by a route practicable for a man or a jaguar. The distance by a practicable route from the present entrance to the cave is about 1600 feet and from the old entrance about 1800 feet. It is possible that a shorter route existed when the footprints were made but this is unlikely. Intensive exploration has revealed no trace of a shorter passage to the surface and the tracks are on a pile of fallen rock and cave clay suggesting that no extensive remodeling of the topography has occurred in this part of the cave since they were made.

The footprints are in a fissure opening into what is called the New Room. This was known before, but was difficult of access and seldom entered until 1940 when a trail was dug through the thick clay deposit that almost sealed the corridor leading into the room. The main floor and ceiling of the room are roughly horizontal but on one side the ceiling slopes upward rapidly and the floor of this fissure-like extension is also steeply sloping and formed by fallen blocks of limestone between and sometimes covering which is much red cave earth and clay. The fissure narrows at the top and finally is nearly closed by rock and by clay evidently washed down from above. It here becomes impassable for a man or any animal as large as a jaguar. Aside from vague markings that may or may not be footprints, two clear, partly superposed prints were found just below this highest

accessible point. The prints are those of an animal traveling straight up the slope. Before reaching this stretch of softer material the animal would have been traveling on rock or on harder earth where the prints would be less distinct. The elevation above the floor of the New Room is about thirty feet. The suggestion is that the animal was lost and climbed the slope in an endeavor, here vain, to find some way out. Darkness here is, of course, absolute and there is no place in the cave more than a few feet beyond the entrance where any glimmer of light penetrates.

The material in which the prints were made is not a pure, slick clay but a sort of earth, clay mixed with very fine sand, of the brick-red color of all the cave earth and most of the soil of the countryside overlying the limestone. The earth is still soft and moist and can have hardened little if any since the prints were made. They were clear and sharp and looked as if they might have been made only a few minutes before their discovery, except that a small amount of loose, almost dry earth and darker dust had drifted into them. In view of the complete absence of dust in the air, even this trivial accumulation might suggest considerable age or a marked change in conditions since the prints were made, but it seems very improbable that there has been any radical change. The presence of some dust in the tracks is consistent with relatively great age, but does not necessarily indicate this. Within historic times even these remote parts of the cave have been frequented both by rats and by bats, and their activities could produce such an effect relatively rapidly.

Since prints in such soft earth were sure to be damaged or destroyed soon, now that the New Room is being opened to tourists, their permanent preservation was assured by filling them carefully with plaster and removing this along with such loose dirt as adhered to it. This mold was carefully cleaned by Otto Falkenbach in our laboratory, a rubber cast made and reversed, and plaster replicas made that faithfully reproduce every detail of the originals.

DESCRIPTION AND IDENTIFICATION OF FOOTPRINTS

The two clear tracks of which replicas were made are partly superimposed, the toes of the posterior print cutting into the central pad print of the other. The prints are probably those of fore and hind feet, the latter impressed later and partly over the former. As would be expected from the steepness of the surface, the anterior ends of the prints are deeper and are very strongly impressed as if the animal were climbing hard, as it must have been, or possibly leaping. The posterior edge would not have shown at all were it not for a strong pressure ridge squeezed up behind it. The mud was also squeezed up to some extent between the toes and more strongly along the right, but not left, side of the tracks. The pressure was mainly backward and to the right and the left margin is relatively shallow and vague. The prints are probably those of left feet and it is also possible that the lateral pressure was increased by the animal's turning toward the left as it stepped out of the second print.

The two prints are alike except in details. Each shows a united central (intermediate, metapodial) pad preceded by three digital (apical) pads. The central pad is relatively small, with the posterior border rounded and the anterior tending to be angulate between the toes. Exact measurement is impossible but the greatest diameter, which is transverse, is approximately 70-75 mm. in diameter on the clearer posterior print. Except for the ridge between them on the impression, the large toe pads begin immediately anterior to this metapodial pad. Each toe pad is oval and elongate anteroposteriorly. Of the three clearly preserved on each print, the two to the left are of about equal size and the one to the right is equally broad, or very slightly broader, but shorter. The impressions of these pads are all longer on the posterior than on the anterior print. The left toe of the three of the posterior print has a clear claw-mark, indicating a large claw barely extending beyond the pad and elevated above the bottom of the latter. A similar claw may be vaguely indicated on the middle toe of this print but is not

visible on the right toe or on any of the anterior print.

There is no identifiable impression of a fourth toe on either print, but the dirt just to the left of the toe impressions was irregular and vaguely depressed. It is entirely possible that another toe here failed to make a clear impression, especially as this side of the prints is less clear in general and the pressure was to the right so that the toe farthest to the left was bearing less weight.

The two longer toe impressions on the posterior print are about 80 mm. in length and the shorter (right) toe impression about 70. On the anterior print the two subequal toe impressions are about 60 mm. in length and the other is about 50. The distance across the three clear toes of the posterior print is about 120 mm. and on the anterior print this dimension is about 130 mm.

The identification of these prints is not obvious and, as is likely to be true of tracks made accidentally under such unusual circumstances, they do not have the clear, diagnostic characters of prints made under ideal and normal conditions. The pressure was oblique, the animal's motion cannot have been a normal stride, the consistency of the medium was uneven, and the surface was steeply sloping. The occurrence of jaguar bones in a distant part of the same cave might have been purely coincidental, but it does show that jaguars did enter the cave, and after study of all reasonable possibilities, I conclude that these are jaguar tracks.

The major difficulties are that these are apparently three-toed prints and that one of them shows claws, whereas jaguar tracks, like those of all felids, normally show four toes and do not show the claws. I have searched the Pleistocene and Recent faunal lists for a three-toed, clawed animal that could have made these prints, and as far as I can learn no such animal is known or is at all likely to have occurred. By elimination, the only alternatives are either that these are not genuine animal tracks or that they were



Fig. 2 Plaster replica of the jaguar footprints, made by filling them with plaster and reversing.

made by an animal of a species normally four- or five-toed. The first alternative will be mentioned again, but it is unacceptable. Adopting the second alternative as a hypothesis, further elimination shows that the tracks can only have been made by a large felid. The apparent absence of the fourth toe (which would in fact be digit V) can be explained as the result of mutilation of the animal or of the imperfection of the print. The first of these possibilities is improbable, and the second is probable and adequate. The prints do not, in fact, prove that this toe was absent on the animal and it is quite possible that it simply failed to be impressed clearly.

For more positive identification, jaguar tracks were made in fine wet sand at the New York (Bronx) Zoo and compared

three-toed and is closely similar to the Craighead prints.

The apparently anomalous claw impression also proves on study rather to confirm than to contradict the identification. The mark is that of a claw that was strongly curved, barely in advance of the apical pad, and considerably above the latter, not showing except in an extraordinarily deep print. These are normal characters of feline claws, and with the living jaguar we found that the claws do show in the same way in a very deep print and especially if the toes sink in more deeply than the central pad. In short, the cave prints are really what would most probably be left by a large feline under the given conditions.

As will be shown elsewhere, the big fe-

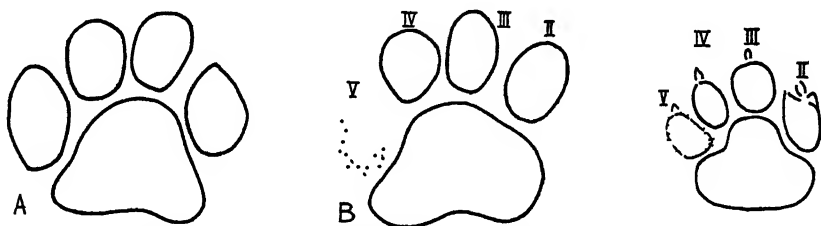


Fig. 3 Sketches of prints of a recent jaguar. A, an average normal print. B, deeper print made with strong, slightly oblique pressure by a swift-moving, leaping animal; the displaced print of the fifth digit is very vague and distinguishable only on close inspection. C, still deeper print, but posterior part relatively shallow; claws show on three of the toes; the print of the fifth digit is shallower and vaguer than the other three.

directly with a replica of the Craighead footprints. The available live jaguar was a rather small female with feet smaller than those of the Craighead cat, but the difference in size of the prints was approximately in the same ratio as the difference between skull and jaw of the living cat and those from Craighead Caverns. The form of the prints matched well except for the imperfections of those from the cave. It was also established that the fifth digit of the jaguar may fail to leave a clear print. The print sketched in Fig. 3B was fairly deep, made with hard, slightly oblique pressure while the animal was moving fast and leaping. The print of digit V is apparently displaced, out of symmetry, and is vague and shallow. Except on close scrutiny the track looked

lines of the North American Pleistocene and Recent can all be classed as pumas, jaguars, and members of the *atrox* group. These prints are small for *atrox* and there is little reason to refer them to that animal, remains of which have not been found closer than about five hundred miles from this locality. Since the tracks look so fresh the pumas living in this region into historic times must be considered. Puma and jaguar prints cannot always be distinguished. The puma has larger feet relative to the skull. The metapodials are longer than in the jaguar, but the foot is more slender, less heavy and stubby, and the plantar areas of the jaguar feet reach larger maximum dimensions than do those of pumas. Large recent male pumas of the *F. concolor oregonensis* or *hippolestes* group

may leave tracks as much as 90 mm. across the three middle toe pads, but probably never much exceed that size. Since this dimension is about 120 mm. in the cave prints, these certainly could not have been made by any recent puma. They could have been made by a jaguar of about the maximum size for males of the largest South American races, and this is about the size of the bones found in Craighead Caverns. Since the prints cannot belong to animals known in the recent fauna of the region, the probability that they do belong to a jaguar of this sort is so great as to amount almost to certainty. That they should have been made by one of the large extinct pumas would be an incredible coincidence.

This occurrence is so remarkable that the thought of a possible hoax is sure to arise, but I am convinced that neither intentional nor unintentional deception has been practiced. The good faith of the discoverers is beyond question, and it is almost impossible that they were them-

selves deceived. Until 1940, it was necessary to crawl to get into this part of the cave. A few persons did penetrate as far as the New Room in 1929, but it was not open to frequent or casual visits. The footprints were not in the room, proper, but up a steep slope that is difficult to climb and that apparently never had been climbed (by humans) until the discovery of the tracks. The nature of the tracks is still more convincing. To make cat tracks of the right size and kind for these jaguars before it was known that any such felines occurred in Tennessee would require quite impossible clairvoyance and technical skill. Moreover anyone desiring to perpetrate such a hoax would surely make normal four-toed tracks: the imperfection of the prints in this respect and their perfection in other respects make a combination readily produced naturally but incredible in an artifact. It is also impossible that the tracks are the result of any natural cause other than their being foot impressions.

TIME OF EXTINCTION OF EASTERN JAGUARS

The jaguar bones found in the cave are unmineralized and are very fresh in appearance in spite of having soaked in limy waters. The footprints looked almost as if made in the last few minutes. The great uniformity and slow change of cave conditions make it possible that the bones and prints are nevertheless old historically, but it is difficult to believe that they are old geologically. The question does not now seem capable of proof, but there are some suggestions, hardly worthy of the name "evidence," that jaguars did survive in eastern North America into the earliest historic times.

On Sebastian Cabot's map of America, 1544, a large spotted cat is shown in what is now eastern United States.¹ Its right hind foot happens to be almost on the spot where jaguar footprints were found in Craighead Caverns. Cabot's evidence, whatever it was, necessarily referred to

living animals. It is possible, as Seton suggested, that a spotted puma was meant. It is also possible that the spots were an error, that an ocelot was intended (but this would be equally difficult to explain), or that the animal was inserted here for decoration and not known or believed to live here. Nevertheless the obvious explanation is that Cabot had some reason for thinking that jaguars occurred in this region, as we now find that they did, at some time or other.

A search, not exhaustive, has been made for archaeological evidence of Indian acquaintance with the jaguar. There is abundant evidence for Mexico and various parts of South America where jaguars still live, but no clear evidence, positive or negative, was found for eastern United States. There are relatively few reliable identifications of animal remains from archaeological sites in the area here considered and many common species of the region are not reported in this context.

¹ A copy of the pertinent part, from the original in the New York Public Library, is given by Neton, 1925, Pl. II.

Zoomorphic art forms were fairly common in the Mississippi Valley and the Southeast, but especially as regards mammals they display more clumsy imagination than skilled observation. Relatively few can be identified, even as to family, in a way satisfactory to the zoölogist. There are some that could—giving the imagination ample scope—be based on the jaguar. For instance, in Holmes, 1903, Plate L, there is a pottery vessel from Tennessee portraying a snub-nosed animal with blunt, erect ears and with designs of concentric circles painted on the body, and Plate XCVIa of the same work shows a very crude clay figurine from Florida remotely suggesting a cat with tail of medium length and with spots at least on the flanks and legs. These could represent jaguars or could represent any of a number of other animals.

On the other hand, the absence of indubitable evidence of Indian knowledge of jaguars in this region does not tend to show that these animals were really unknown to the Indians. As far as my cursory review of the literature shows, there is similar absence of certain archaeological evidence of the puma, which the Indians all certainly knew very well, as well as of numerous other common species surely present here in Indian times.

Miss J. M. Lucas has kindly searched much of the pertinent historical literature for references to the occurrence of jaguars east of the Mississippi in European travelers' accounts. No indubitable evidence was found and there are few remarks that could possibly apply to these animals. The most interesting of these vague legends were cited by Jefferson (1799) in his efforts to prove that a great cat was then living in the mountains of the "West"—which then included eastern Tennessee.¹ Some of

these accounts probably refer to the puma, magnified by terror and by repetition. It cannot be said that any necessarily had a factual basis other than the puma, but in at least one instance, that of "a person of the name of Draper" on the Kanhawa in 1790, Jefferson was insistent that the animal in question could not be that "mis-called the panther" (i.e., the puma). Spots are not mentioned in any of these tales, an omission that prevents accepting any as clearly referring to the jaguar but that does not exclude the possibility.

Jefferson said that these stories had become discredited in his day because no one produced remains of the reputed big cat. He proposed to substantiate the legends by equation with the "great-claw" bones in his possession. But this attempted substantiation was itself thoroughly discredited by Wistar's correct identification of these bones as belonging to a giant sloth, and not to a cat.² By a perversion of logic, which my colleagues have apparently shared with me, it has been felt that the error in identification disproved the belief in "great-claw," the cat, which turned out to be *Megalonyx*, the sloth. In fact the stories of the big cat came first. Jefferson believed that a great cat had existed in the region in historic times, and then attempted to identify the bones in hand as belonging to the cat. The error in identification certainly does not mean that no such cat existed.

Indeed a great cat, one larger and (no doubt) fiercer than the puma, did exist in this region, for here are the fairly fresh bones and very fresh footprints from Craighead Caverns. The equation of the

¹ Jefferson referred especially to western Virginia (which included Kentucky until 1792), but also to the West in general. Tennessee was still the frontier when Jefferson wrote, its first white settlements only thirty years old and statehood not granted until 1796. Eastern Tennessee, where the cave is, had successively been included in North Carolina, in the forgotten State of Frankland or Franklin, in North Carolina again, and in the "Territory South of the Ohio River." The border with North Carolina was not established until 1915, but the region of Craighead Caverns was known to belong to Tennessee even in Jefferson's day.

² While on the subject of legends, this may be an appropriate occasion to point out that the place in the history of our science usually given to Jefferson is also legendary. Jefferson did not found the science of vertebrate palaeontology in America and had, even for his day, only the most amateurish and casual of contacts with it. He was not the first to describe fossil bones from this country. He did not find the *Megalonyx* bones. He did not correctly identify them and his description—in contrast with that of Wistar in the same year—was poor and inaccurate. He coined the word "megalonyx" as a fancy vernacular equivalent of "great-claw" but he did not found the genus *Megalonyx*. Such as it was, Jefferson's interest in paleontology was a symptom of a wide-ranging mind, but the honor commonly done him by vertebrate paleontologists is rather a reflection of his extraordinary eminence in other fields than a just appraisal of his accomplishments in this. Its basis is sentimental rather than historical.

Craighead cat with Jefferson's cat, that of the legends and not of the sloth bones, is a different matter. It does seem possible that after all these years authentic remains have been found that belong to the cat in whose existence Jefferson believed so earnestly. This is purely speculative, however, and probably cannot now be proved, one way or the other.

As regards the possible historic occurrence of jaguars east of the Mississippi, there are two quite different problems: whether jaguars like the Craighead cat survived there and whether jaguars like those of Mexico and Texas strayed into this region. That jaguars have occurred widely in recent times in southern Texas, and probably still do occasionally in the most remote parts, is well established by the evidence of Audubon and Bachman, Baird, Bailey, and others. The most eastern definite records almost reach the Louisiana border, but I do not find any authentic and explicit record east of the Sabine River. Audubon and Bachman said that jaguars formerly occurred in Louisiana and northward, but they gave no circumstantial evidence for this. Baird, too, thought that jaguars had been killed in what is now Louisiana, but gave no reliable record. Jaguars are individually wide-ranging, cross large rivers without serious difficulty, and have been authentically reported as far north as Tennessee (but much farther west) and in still colder and drier climates. There is, then, no reason why jaguars should not have strayed from their positively known historic range as far as Tennessee. On the other hand, there is no worthy evidence that they have done so in historic times. In addition to

the Craighead cat, the direct evidence of jaguars north and east of their established historic range consists of scattered finds comparable to but less complete than that of Craighead Caverns. The Texas jaguars belong to the *Panthera onca hernandesii* group, and probably to *P. o. veraecrucis*, if that is a valid subspecies. The Craighead cat is comparable in size and some other characters with the largest individuals of the largest living races, in Matto Grosso and the Chaco, and significantly different from any recent jaguars of Mexico or the United States. This discovery and the others that have been made and become identifiable by comparison with this do not show strays from the recent jaguar range, but a separate subspecies now extinct, whenever its extinction occurred.

Some of these discoveries, to be reviewed in a separate paper, were made in old strata definitely Pleistocene in character and in associated fauna. None seems to be younger than the Craighead cat and the question of possible recent survival depends, at present, on the latter.

A curious parallel adds to the interest of this tenuous possibility of jaguar survival. There are similar, but somewhat more definite, legends of the presence of a great cat in Patagonia in early historic times, into the 18th century. Cabrera (1934) has shown that these accounts may be true and may refer to the extinct form that he has called *Panthera onca mesembrina*. It is thus barely possible that both the now extinct largest marginal races of jaguars, one in the extreme south and one in the north and northeast, did not become extinct until after the beginning of European settlement in America.

KYLE QUARRY

A few fossil bones were found in a limestone quarry about three-quarters of a mile south of the present entrance to Craighead Caverns on the property of Mr. George Kyle. Through Mr. Kyle, Dr. Cameron, and Mr. Michael, bones that had been picked up by workmen in the quarry were presented to the Museum and some others

were found in place during my visit. The known underground passages of the cave approach within perhaps a quarter of a mile of the quarry, and it is quite possible that small fissures in cave and quarry are in actual communication. Nevertheless the two bone occurrences have no probable relationship beyond the indirect relation

that both involve Pleistocene fissure formation in the limestone belt, as do other occurrences over a space of hundreds of miles. The proximity of these two discoveries is purely coincidental. The bones in the cave were certainly not derived from the quarry deposit or one like it, and there is no necessary or probable close equivalence in age beyond the fact that both are doubtless pre-historic and post-Pliocene. The bones in the cave are fresher in appearance, those in the quarry more heavily mineralized and there is a definite impression that the latter are older, but this cannot be established as a fact.

The bones found in the quarry are in old solution passages of variable diameter not exceeding a few feet. Where the bones were found, these cavities are completely filled with red clay, typical cave-earth of the region, with a few broken limestone fragments and some secondary deposition of calcite. The bones so far recovered were apparently not more than about ten feet from the surface as it was when the quarry was opened. Most of the bones were broken before burial and all the teeth so far recovered had fallen out of the jaws and scattered, although in two cases teeth found near each other in the matrix appeared to have been of the same animal. The fragments are distributed rather sparsely through the clay, with no rich accumulation. Apparently these are the remains of skeletons that disintegrated on the surface and were washed into open fissures from time to time.

The fossils found at this locality do not lend themselves to unequivocal identification of species. The following forms are indicated:

SNAKE—a group of associated but dislocated vertebrae. These seem to have been deposited in a secondary fissure in the clay, but are preserved as are the other bones and are probably nearly or quite as old.

TURTLE—one incomplete costal plate.

BEAR— P^4 and M^1 , found separately but probably of one individual, distal end of humerus, scapholunar, pisiform, distal end of tibia, metapodials, phalanges, etc. These bones show various small differences from recent specimens but are very close to *Ursus* (*Euarctos*) *americanus* and probably inseparable from that species. Most of the specimens represent an unusually robust individual.

OTTER—humerus, lacking both ends, proximal end of radius, and perhaps a few other fragments. These specimens are hardly identifiable, but they do agree closely with a large *Lutra canadensis*. Reference to some extinct species, like *Lutra rhoadsi*, is equally possible.

BOBCAT—upper canine and perhaps foot fragments. These, too, are not positively identifiable but agree well with *Lynx rufus*, as far as they go. Pertinence to some extinct form like *L. calcaratus* is not excluded.

TAPIR—mainly represented by four upper teeth, probably left P^{2-3} , right P^4 , and left M^1 . These were all isolated, as found, but the P^{2-3} , at least, seem to belong to one individual. More exactly identifiable than anything else from the quarry, these teeth closely resemble *Tapirus veroensis* Sellards and can be closely matched by teeth of that species from the Seminole Field, Fla. I applied the name *T. veroensis sellardsi* to these latter specimens, but the subspecies was poorly founded and is probably invalid. The geographic occurrence is nearer *T. tennesseae* Hay, but size and morphology are probably nearer the Florida type. Hay's species was based on inadequate data and poorly defined. It is probably a synonym of *T. veroensis*, a probability somewhat enhanced by the present occurrence. *T. veroensis* was based on excellent diagnostic material and was well defined, even though its probable separation from *T. haysii* cannot be considered absolutely certain because of the less complete knowledge of the latter. The following measurements show the size relationship:

	P^2				P^3		P^4		M^1	
	Length	Width Ant. Post.	Length		Ant. Post.		Ant. Post.		Ant. Post.	
Kyle Quarry	19.3	21.9 23.5	19.4		24.1 24.0	19 9	ca. 26 24.6	25.0	28.5 24.1	
<i>T. veroensis</i> , Type	18.5	23	19		24	20	26	24	28	
<i>T. haysii</i> , ref.	20.5	26	22.5		26	26	28	26	31	

The comparative measurements are from Sellards (1918), the *T. haysii* teeth being from Port Kennedy, Pa. Hay's measurements of *T. tennesseae* are not compared because the dimensions that he gives for upper teeth are anomalous and those teeth may have been incorrectly placed in the series. The differences in size and structure from *T. veroensis* seem to me to be well within the probable range of individual variation.

PECCARY—broken lower canine. Probably peccary, but otherwise indeterminate.

DEER—two broken astragali and a proximal phalanx. These do not seem significantly unlike recent specimens of *Odocoileus virginianus*, but again there are supposedly extinct species like *O. laevis* to which the fossils could belong.

For what it is worth, this list suggests a typical Pleistocene fauna of this region. For instance, Hay's list of cave or fissure specimens from Whitesburg, Tenn. (Hay, 1920), includes bear, tapir, peccary, and deer, inseparable from the Sweetwater forms as far as comparison is possible. *Lutra* and *Lynx* do not appear to have been reported as fossils from Tennessee, but they are common enough in similar collections from nearby states. The Port Kennedy Cave, in Pennsylvania, contained animals

allied to all those found in the quarry near Craighead Caverns: snakes, turtles, black bear, otter, bobcat, tapir, peccary, and deer.

There is no proper basis for an age determination more exact than that the fauna is certainly post-Pliocene and pre-historic. It is in general of the type called "Pleistocene," and could even be old Pleistocene, but there is good evidence that all these sorts of animals also survived into the Recent in North America. The tapir and perhaps the peccary, however, probably became extinct in the early Recent, perhaps ten thousand years ago or more, and the degree of fossilization and geologic occurrence are also better consistent with an age greater rather than less than about ten thousand years.

As a locality record, this occurrence has sufficient interest to merit this brief note, but otherwise it is of little importance. Its chief value may be to direct attention to a region and to conditions where more abundant and more complete specimens may be found at any time.

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AMERICAN MUSEUM NOVITATES

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THE DENTARY OF *SYLLOMUS CRISPATUS* COPE

By CHARLES T. BERRY¹

In 1937² I added to Cope's type of *Syllumus crispatus* Cope by a find consisting of the nuchal, first to seventh neurals, second postneural, first suprapygal and portions of all the costals, portions of first, second and eleventh right peripherals, first to sixth and eleventh left peripherals, pygal, portions of left hypoplastron, right and left hypoplastron, right and left xiphiplastron, portions of right and left scapular, pubis, coracoid, ischium, the left parietal and several vertebrae.

first neural and a portion of the third, portions of the first to fourth right costals, portions of the first to third left costals, second to fifth and portions of the sixth right peripherals, first and second and portions of the third left peripherals and portions of the plastron which were not complete enough to identify.

All of these carapace bones were slightly larger than those belonging to the specimen described in 1937. The sculpturing is the same except there is a slight differ-



1



2

Fig. 1. Dorsal surface of dentary of *Syllumus crispatus* Cope (A.M. No. 1679). $\times 1$.

Fig. 2. Ventral surface of dentary of *Syllumus crispatus* Cope (A.M. No. 1679). $\times 1$.

This material was collected about 7 feet above the beach at the southeastern end of Horsehead Cliffs (Nomini Cliffs), Westmoreland County, Virginia. The age of the beds is Miocene.

On June 9, 1940, I revisited these cliffs and collected portions of another specimen of *Syllumus crispatus* Cope, from the same horizon and at approximately the same locality. This specimen was not nearly as complete as the first, consisting of the

ence in the location of the sulci on the costals and neurals.

In addition to these carapace bones and associated with them there was the dentary bone of the mandible. It is this bone that I wish to briefly describe.

In outline the dentary is a modified rectangle, one corner being oriented anteriorly. The two anterior sides form slightly concave margins while the posterior sides are irregular. The dorsal surface (Fig. 1) is very uneven, the anterior portion being concave while the posterior is slightly convex. Separating these two

¹ Johns Hopkins University.

² More Complete Remains of a Chelonian, *Syllumus crispatus* Cope, from the Miocene of Virginia, Amer. Mus. Novitates, No 953, pp. 1-12.

regions is an area which is coarsely pitted and nearly parallel to the anterior margin. The anterior surface rises very steeply to form the thin, sharp anterior margins. The ventral surface (Fig. 2) of the bone is convex, being covered by fine grooves and ridges irregularly arranged. Near the anterior margin the surface texture abruptly changes so that there is a band around this portion of the dentary. The band decreases in width from approximately 6 mm. at the anterior apex to about 2 mm. at the posterior corner.

The right posterior corner of the plate has been broken off so that the bone is

not symmetrical. Likewise the posterior portion is rounded, as if eroded, showing no area of contact with the other bones of the mandible.

This dentary is 34 mm. broad (greatest measurement) and 38 mm. in an anterior-posterior direction.

The presence of any bone of the skull or mandible in these deposits is exceptional. Thus this incomplete specimen of the dentary and the left parietal (the latter described in 1937) are the only bones of the skull belonging to *Syllomus crispatus* Cope that are known up to the present writing.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XLV¹

NOTES ON NEW GUINEA BIRDS. VIII²

BY ERNST MAYR

FALCONIDAE

THE GEOGRAPHICAL VARIATION OF *FALCO PEREGRINUS* IN THE PAPUAN AND AUSTRALIAN REGIONS

Work in this species is handicapped by the scarcity of material from the tropical parts of the range. The Rothschild collection, for example, does not contain a single specimen from Borneo, the type locality of *ernesti* Sharpe, or from any of the other Sunda Islands. On the other hand, the Whitney-Rothschild collection contains ten specimens from New Guinea and New Britain. A single adult male from Celebes (Heinrich coll.) agrees perfectly with a series of four adult males from New Guinea and New Britain. If all of these birds are different from *ernesti* (Borneo), a point which I cannot decide for lack of material, the New Guinea population would have to take the name *heinrichi* Kleinschmidt given to a Celebes bird (type, Museum König, Bonn). According to Stresemann (1940, Journ. f. Orn., LXXXVIII, p. 469) there is no difference between Celebes and Java birds. The picture of Java birds published by Kuroda (1936, Birds of Java, II, Pl. XXIII) also agrees very well with the New Guinea series.

Falco peregrinus ernesti Sharpe

CHARACTERS (based on the New Guinea series).—Upper parts very black with ir-

regular gray bars on middle and lower back, getting more pronounced on rump and upper tail-coverts; throat and breast rather pale with a not very pronounced rufous ochraceous wash; cheeks and malar region solid black; lower breast, abdomen, flanks, and under tail-coverts gray, heavily barred with black; most specimens also show a slight rufous wash of the under parts, particularly the females; immatures lack the grayness of the under parts but are very heavily streaked, on the flanks these streaks broaden to bars.

Wing, ♂ ad. 277, 279, 283, ♀ ad. 319, 322, 330, 331, 340, ♀ imm. 322, 328, 330. Culmen (from cere), ♂ ad. 20, 20, 21, 21, ♀ ad. 23, 24, 24.5, 25, 25, ♀ imm. 22, 24, 24.

Of Australian birds (*macropus*), not enough material is available to judge geographical variation. A single specimen from southwestern Australia is much more rufous underneath than eastern Australian birds. It was named *submelanogenys* by Mathews. A single adult female from northwestern Australia (Capt. Bowyer Bowen coll.) is much paler above and below than eastern Australian birds and has the barring of the under parts reduced. How far these differences are due to individual variation and how far to geographical variation cannot be decided on the basis of the present material.

East of Australia, on the New Hebrides, lives a form which in its characters is some-

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, 977, 986, 1006, 1007, 1056, 1057, 1091 and 1116.

² The present paper is the last in my series of revisions of New Guinea genera. Submitted to the editor on Nov. 10, 1940

what intermediate between the New Guinea and the Australian falcons but which is quite distinct from either race. It may be characterized as follows:

Falco peregrinus nesiotés, new subspecies

TYPE.—No. 306376, Amer. Mus. Nat. Hist.; ♂ ad.: Tanna Island, New Hebrides; April 8, 1936; L. Macmillan coll.

ADULT MALE.—Upper parts as black as those of *ernesti*; under parts similar to those of *macropus* (Australia), but black bars heavier; breast and under parts more deeply washed with rufous; black bars on under wing broader and more numerous, pale bars on primaries less pronounced; differs from *ernesti* by the much less heavy barring of the under parts, by the reduction of the gray wash to flanks and thighs and by the deeper rufous wash of the under parts.

ADULT FEMALE.—Differs from *macropus* by the blackish upper parts and the much more heavy barring of the under parts, and from *ernesti* by the absence of the gray wash of the under parts, the narrower black bars and the stronger rufous wash.

Wing, ♂ ad. 287+, ♂ imm. 295, ♀ imm. 327; tail, ♂ 131, 142, ♀ 160, 161; culmen, ♂ 18, 19, ♀ 22, 23.

RANGE.—Tanna Island, New Hebrides,

and Beupre Island, Loyalty Islands. Also observed by Macmillan on Uvea, Lifu and Maré Islands, Loyalty Islands. Reported by Layard from Efate, New Hebrides, and from New Caledonia. The species is, undoubtedly, present on all the islands where suitable cliffs exist.

This falcon has also been found in the Fiji Islands, but the material before me is very unsatisfactory. It consists of a native collected flat skin from Taviuni (♀ ad.) and an adult male in excellent condition which died after having lived in the New York Zoological Park for one year and four months. The captivity bird is much deeper rufous chestnut below than any of the wild-killed males of the neighboring races. The barring of the abdomen is intermediate between *ernesti* and *nesiotés*, and there is a considerable amount of gray wash, though not quite as much as in *ernesti*. I prefer to keep the Fiji population with *nesiotés* until more adequate material is available.

MUSCIPIDAE

ON RHIPIDURA RUFIFRONS LOUISIADENSIS HARTERT

In a recent note in the Ibis (1938, p. 762), Charles M. N. White suggests that *Rhipidura rufifrons louisiadensis* Hartert might be based on migrating specimens of *Rh. r. rufifrons* (Latham) from Australia. This suggestion is quite misleading. *Rh. r. louisiadensis* has nothing to do with *rufifrons*, but it is closely related to *granti* and *commoda* from the Solomon Islands, differing from *granti* by the brown (not black) ear-coverts, and from *commoda* by its larger size (wing, ♂ ad. 76–81, ♀ ad. 71–75).

It differs from *rufifrons* by the much deeper coloration throughout. Forehead, lower back, rump and base of tail are deep rufous tawny, almost chestnut. The brown of crown and upper back is washed with rufous. The black spot on the throat

is much larger. All the tail-feathers, except the central pair, are broadly tipped with pure white, while in *rufifrons* they are only shaded with pale buffy gray. Tail longer, about 83–93, against 75–85 in *rufifrons*.

I have examined 31 specimens of *louisiadensis* from various localities in the Louisiades and the D'Entrecasteaux Archipelagoes. Many were in breeding condition and most of them were collected during November to February, the Australian breeding season. Not one of the specimens from the Louisiades in the American Museum (including the Rothschild coll.) belongs to typical *rufifrons*. The winter range of *rufifrons* is apparently restricted to the Fly River region and the Gulf of Papua.

NOTES ON THE GEOGRAPHICAL VARIATION OF *MONARCHA ALECTO*

In 1928 G. M. Mathews (Bull. Brit. Orn. Club, XLVIII, p. 93) described some subspecies of this species, but as Dr. Hartert pointed out correctly (1930, Novit. Zool., XXXVI, p. 72), he compared his "new" forms in every case with those of other races of the species to which they were the least related. In a recent paper (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 151) Rand and I pointed out the fact that there was considerable variation within the range of so-called *Monarcha alecto chalybeocephalus* and that the species was in urgent need of revision.

The following forms can be recognized:

Monarcha alecto alecto Temminck, 1827—northern Moluccas.

Monarcha alecto longirostris Mathews, 1928—Timorlaut.

These two forms are outside the scope of the present paper and shall not be discussed further. I may mention, however, that the adult females of *alecto* differ from New Guinea females by having the back washed with grayish which gives it an olive hue instead of the bright chestnut of *chalybeocephalus*.

Monarcha alecto nitidus Gould, 1841—northern Australia.

Mathews has separated from this form not less than four other subspecies. Prior to additional revisionary work, I shall group all Australian birds under the name *nitidus*. The females of this form have a very dark and dull rufous brown back, but the metallic blue of the crown does not spread to the upper back.

A series collected on Daru Island by the Archbold Expedition of 1933-1934 belongs clearly to this race. It is probable that the species breeds on Daru Island and is not just a winter visitor from Australia. *Monarcha alecto rufolateralis* Gray, 1858—Aru Islands.

A very dark race. The metallic blue of the crown spreads in the adult female onto the upper back.

Monarcha alecto manumudari Rothschild and Hartert, 1915—Vulcan Island.

The largest race. Gloss of males rather greenish.

These are the clear-cut races. The remainder of the range of the species, com-

prising all New Guinea, the eastern and western Papuan Islands, the islands of Geelvink Bay, the Bismarck Archipelago and the Admiralty Islands are occupied by an intergrading and irregularly varying assemblage of populations.

Fairly clear-cut, but tending to intergrade on the D'Entrecasteaux Archipelago is the form of the Louisiades:

Monarcha alecto lucidus Gray, 1858—Sudest Island.

Size large, particularly of the bill: adult females light chestnut, distinctly lighter than New Guinea birds.

Seven females from Sudest and St. Aignan form a uniform series with very little individual variation. The darkest specimen is slightly lighter than the two darkest birds of a series of 16 adult New Britain females, and only the lightest Sudest bird falls outside the darkest third of the New Britain series.

Woodlark Island (7♀) and Trobriand Islands (2♀).—Form a uniform series which agrees perfectly with Sudest Island birds.

D'Entrecasteaux Archipelago.—Four of the five adult females form a uniform series and fall within the darkest third of the New Britain series. One single bird, however, is darker than the darkest New Britain bird, but agrees quite well with New Guinea specimens.

Monarcha alecto chalybeocephalus Garnot, 1828—New Ireland.

Under this name a great number of island populations are combined in some of which the females have a pale back, in others a dark chestnut one.

Pale birds are found on New Hanover, New Ireland, New Britain, the French Islands, Rook Island, Dampier Island and in the Astrolabe Bay district in New Guinea.

Dark birds are found on Feni Island, all New Guinea, Japan, Waigeu and Misol.

Very dark birds on the Admiralty Islands, Numfor and Biak. In view of the irregularity of this distribution and the considerable individual variation exhibited by the birds of the larger islands (for example, New Britain) it seems inadvisable to recognize two names, one for the populations

with light females (*chalybeocephalus*) and one for those with dark females (*novae-guineensis* Mathews). Dr. Hartert had already reached the same conclusion (1930, *loc. cit.*).

The gloss of males is sometimes more bluish, sometimes more greenish, but exceedingly variable within each population.

This character is of no help in subdividing the above united assemblage of populations. Size variation is irregular. Populations from the following islands show large measurements and might conceivably be included with *lucidus*: Numfor, Dampier Island, and Manus, Admiralty Islands.

NOTES ON *POECILODRYAS PLACENS*

Poecilodryas placens (Ramsay)

There are absolutely no differences between fresh specimens from southeastern New Guinea, Astrolabe Bay and the type

series of *clara* (*steini*) from the lower Menoo River. *Poecilodryas placens clara* Stresemann and Paludan must, therefore, be considered a synonym of typical *placens*.

THE GENERIC CLASSIFICATION OF SOME NEW GUINEA FLYCATCHERS (*MICROECA-POECILODRYAS* GROUP)

The generic subdivision of the New Guinea flycatchers has been a puzzle to the taxonomist ever since the various species were discovered. In recent years Mathews "simplified" matters by providing a generic name for nearly every species he knew. In many of the cases this was done without stating the characters that actually separate it from its nearest relative. In the difficult *Microeca-Poecilodryas* assemblage, we can distinguish two main groups, the *Microeca* group consisting of true flycatchers and the *Poecilodryas* group consisting (more or less) of undergrowth dwellers.

MICROECA GOULD

TYPE.—*Microeca leucophaea* (Latham).

A medium-sized species with a rather small and flat bill; feet weak and tarsus rather short (18–19% of the wing); tail short (63–64% of the wing). Detailed generic diagnosis in Mathews, *Birds Australia*, VIII, p. 62.

The following Papuan species are usually included in this genus:

Microeca flavigaster

Structurally very close to *leucophaea*. Fourth primary longest, third and fifth subequal instead of $3 = 4 > 5$. Tail slightly longer (65–68% of the wing), tarsus shorter (17–18%).

It is quite impossible to separate this

species generically from *Microeca* and *Kempia* Mathews is a clear synonym of *Microeca*.

Microeca griseiceps De Vis

A small species with rather weak feet (tarsus 17–18% of wing) but long tail (73–78% of wing). The first primary is much longer than in *leucophaea* (more than 50% of the second, against 35–40% in *leucophaea*).

In all other characters this is a typical *Microeca* and no reason exists to recognize *Kempiella* Mathews. Each one of these species presents certain structural peculiarities, but it would lead much too far to recognize monotypical genera for all of them.

Microeca flavovirescens Gray

A large bird also with a long tail (74–75% of wing), but with comparatively weak legs (tarsus 17% of wing). Bill rather long and deep and with a strong hook at the end. Second primary very short, first primary about 48% of second. Mathews proposed the genus *Dikempia* for this species (*Birds Australia*, VIII, p. 73).

Microeca papuana Meyer

A small bird with a short tail (60–63% of wing), but with strong feet and a long tarsus (22–24% of wing). The wing for-

mula is $4 = 5 > 3 > 6 > 7 > 2$. The first primary is 54% of the second. The bill is comparatively small and flat. Mathews created the genus *Devioeca* for this species which is possibly justified as a subgenus.

In all these species the females are colored as the males and the birds in first-year plumage resemble adults except for wings and wing-coverts.

The juvenal dress is worn only for a very short time and is, therefore, unknown in some of the species, as for example, in *griseiceps*. In the species in which it is known (*leucophaea*, *flavigaster*, *flavovirens*) it lacks the yellow lipochrom completely. The upper parts are brown with white tips on the feathers, the under parts are white with a liberal amount of brown, particularly on throat, breast and flanks. The juvenal plumage of *papuana* is not yet quite understood, since only immature birds with remainders of the nestling (juvenal) plumage are known. It is probably like that of the other species, but it is also possible that the feathers of the back are olive with yellowish-white tips. Such feathers are scattered through the back of immature birds, but do not seem to belong to the immature plumage.

TREGELLASIA MATHEWS

This genus was created for "*Eopsaltria*" *capito* Gould and in it was later included "*Poecilodryas*" *leucops* (Salvadori).

The genus differs from *Poecilodryas* principally by the flat bill and from *Microeca* by the much stronger feet and longer tarsus.

The type species is *capito* in which the tail is rather long (70–71% of the wing) and the tarsus 26.5–28.5% of the wing. The wing formula is $4 = 5 > 6 > 3 > 7 > 8 > 2$. The first primary is short and the second very short.

Also included in this genus might be *leucops* with a much shorter tail (64–65% of the wing) but an equally long tarsus (26.5–27.5% of the wing). The bill is exactly as in *capito*. The wing formula is $4 = 5 > 6 > 3 > 7 > 8 = 2$. First and second primaries are short, the first being exactly 50% of the second.

The genus differs from *Microeca* by its

stronger and larger bill, its stronger feet and its more rounded wing. These characters are correlated with the habits of the species of this genus. They are not strictly flycatchers who sit quietly on a branch and catch flying prey, but they search for their food actively clinging to vines and searching through the undergrowth.

Ogilvie-Grant (1915, Ibis, Suppl., p. 161) has also placed *M. papuana* in this genus. This species is intermediate between *Microeca* and *Tregellasia* in the structure of its feet and in its wing formula, but it is better included in *Microeca*, principally on the basis of its bill.

The juvenal plumage in this genus is quite unlike that of *Microeca*. It is not spotted, but uniform brown, darker above and paler below. The middle of the upper throat is particularly pale and there is sometimes a faint streaking (light shaft-streaks) on the crown. The upper wing-coverts are brown as the back, but wing and tail-feathers are olive. The first-year plumage, which is acquired through an incomplete molt, retains the primary-coverts and some of the greater upper wing-coverts in addition to wing and tail-feathers.

Nestlings are similar to such of *Pachycephala*, but are dull brown, not rufous brown.

POECILODRYAS ASSEMBLAGE

There are eight species of birds on New Guinea which are usually included in the genus *Poecilodryas*. For these eight species Mathews uses seven genera: *Poecilodryas* (*hypoleuca*), *Leucophantes* (*brachyura*), *Penneoenanthe* (= *Quoyornis*) (*pulverulenta*), *Papualestes* (*cyana*), *Peneothello* (*sigillata*, *bimaculata*), *Gennaeodryas* (*placens*) and *Plesiodyras* (*albonotata*). Such an arrangement of monotypic genera is very unsatisfactory because it makes the use of specific names superfluous and is, furthermore, a severe handicap of the taxonomist's memory. On the other hand, *Poecilodryas* (*sensu lato*) is admittedly a heterogeneous assemblage.

Lacking anatomical evidence (which most likely would not be of any help anyhow) there are three sources of evidence toward a generic classification: (1) structure of bill, feet, etc., and proportions; (2)

color pattern of the adults; (3) color of the nestling plumage. On the basis of such evidence I would like to suggest the following subdivision of the *Poecilodryas* assemblage.

POECILODRYAS GOULD

TYPE.—*Poecilodryas superciliosa* Gould.

A medium-sized bird with long tail (77–82%) and medium-sized tarsus (25.0–25.6%). The bill is strong, but flat, with a well-defined ridge on the culmen and a hook on the tip. The rectal bristles are long and strong. The wing is rounded $4 = 5 = 6 > 3 > 7 > 8 > 9 > 2$. The first primary is very long (about 60% of the second). The color pattern is characteristic: under parts whitish, upper parts dark; a broad white wing-bar and white tips of the tail-feathers; lores and supercilium are white.

The juvenal plumage is plain brown, wing and tail being similar to that of the adults.

The following New Guinea species also seem to belong to this genus:

Poecilodryas brachyura Sclater

Very similar to *superciliosa* in general size, proportions and color pattern. Differs by not having any white on the tail, by having yellow feet and by the much shorter tail. The tail is about 60–63% of the wing and the tarsus 24.5–25.5%. There is no doubt that this species is congeneric with *superciliosa* and that *Leucophantes* Sclater is a synonym of *Poecilodryas*.

Poecilodryas hypoleuca Gray

General color pattern and proportion very similar to those of *superciliosa*. The tail is about 71–72% of the wing and the tarsus 24–25%. There is a little white on the tip of the outermost tail-feather and two large triangular black spots on the sides of the breast. The wing formula is $4 = 5 = 6 > 7 > 3 > 8 > 9 = 2$ and the first primary is 54% of the second.

No specimens in complete juvenal plumage seem to be known of either *brachyura* or *hypoleuca*, but several specimens in partly immature plumage permit a reconstruction of the juvenal plumage which seems to agree with that of *superciliosa*,

possibly with more white on the lower abdomen.

We now come to three species which might be included in *Poecilodryas*, partly because their plumages are not completely known and partly to avoid putting them in monotypic genera.

Poecilodryas pulverulenta (Bonaparte)

A medium-sized bird with medium proportions (tail 71–76.5%; tarsus 24.5–26% of wing). Wing formula: $4 = 5 = 6 > 3 > 7 > 8 = 2$. First and second primaries long; first primary is 60% of the second. The general coloration is dark above and whitish below, no supercilary marks or white wing-bars, but with the base of the tail white. The species is remarkable for its *Pachycephala*-like compressed and small bill and the weakly developed rectal bristles. The juvenal plumage is described by Mathews (Birds Austr., VIII, p. 275). It differs from that of *Poecilodryas* by the greater amount of white on the abdomen and the rather spotted or streaky appearance of the brown of the upper parts. The species is a mangrove-dweller and likes to feed on the ground.

Poecilodryas placens

A very large bird, with a short tail (60–61%) and a short tarsus (23.5–24.0%). Wing formula: $4 = 5 > 6 > 3 > 7 > 8 > 2$. The first primary is rather long, the second rather short, the first primary is 57% of the second. The bill is a typical *Poecilodryas* bill, but the coloration differs strikingly from the other species of *Poecilodryas* by the presence of olive above and yellow below. There are no white marks on wing or tail. The juvenal plumage is unknown. This species is, apart from its coloration, a typical *Poecilodryas*.

Poecilodryas albonotata

A very large species, with a medium sized tail (70–73.5%) and a rather short tarsus (22–23.5%). The bill is very large but not really out of proportion with the generally large size. The wing formula: $4 > 5 > 3 > 6 > 7 > 2 > 8$; both first and second primaries are rather long, the first being 54% of the second. The coloration

fits fairly well into the genus *Poecilodryas*, except for a large black shield on the throat. The tail is uniform, but the typical *Poecilodryas* pattern is indicated on the outside of the wing and there is a white bar across the inner webs of the wing-feathers. The juvenal plumage is uniform pale cinnamon, except for the two white throat patches which are already present in this plumage. The species really possesses no character which would exclude it from *Poecilodryas*.

PENEOTHELLO MATHEWS

TYPE.—*Poecilodryas? sigillata* De Vis, 1920, Birds of Australia, VIII, p. 185.

Peneothello sigillatus

A fairly large species, with a medium-sized tail (69–73%) and a very long tarsus (30–32.5%). The bill is comparatively small, laterally compressed and not broadened at the base as in the typical species of the genus *Poecilodryas*. The rectal bristles are comparatively short and weak. The wing is rounded: $4 = 5 = 6 > 3 > 7 > 8 > 9 > 10 = 2$. The second primary is about as long as the secondaries, the first primary is about 57–62% of the second. The coloration differs remarkably from the typical *Poecilodryas* style. It is all black with some white on the inner secondaries and (in *quadrimaculatus*) on the sides of the breast. The juvenal plumage is of a dark rufous brown with pale buffy tawny shaft-streaks. Upper wing-coverts, wing- and tail-feathers have pale tips. This streaky juvenal is rather different from the more or less uniform brownish plumage of juvenal *Poecilodryas*.

Peneothello cyanus

A fairly large species, with a rather short tail (66–69%) and a fairly long tarsus (26–27%). Bill as in *sigillatus*. The coloration is a more or less uniform dark gray-blue. The wing is not quite as rounded as in *sigillatus*: $4 = 5 = 6 > 3 > 7 > 8 = 2 > 9$. The second primary is somewhat longer than in *sigillatus*, the first 56–59% of the second. The juvenal plumage is exactly as in *sigillatus*, only darker, and the shaft-streaks narrower.

Peneothello cryptoleucus Hartert

A medium-sized species, with a medium-

sized tail (73.5–74.5%) and a very long tarsus (31–33.5%). The wing is round: $4 = 5 > 6 > 3 > 7 > 8 > 9 > 2$, the first primary being 55–58% of the second. The coloration is uniform (pale gray below, blue-gray above), with a hidden white area on the inner webs of the inner primaries. The juvenal plumage is unknown, but remainders of it in a first-year bird suggest that it is very much as that of *cyanus*.

The three species just mentioned, although showing some minor variation of proportions, differ from *Poecilodryas* in the coloration of the juvenal plumage, in general color pattern, in the small, laterally compressed bill, in the long tarsus, and other features (shape of first primary and of the tail-feathers). It seems justified to recognize for these species the genus *Peneothello* Mathews, of which *Papualestes* Mathews is a synonym. *Peneothello cryptoleucus* is a perfect link as far as the proportions go, between *cyanus* and *sigillatus*.

This leaves one species to be discussed, *Peneothello bimaculatus*. This species does not fit at all into *Poecilodryas*, but it also differs in several important aspects from *Peneothello* (tarsus, juvenal plumage). Until more is known about nest, eggs and habits of this species, the creation of a monotypic genus for this species should be avoided.

Peneothello bimaculatus

A fairly large species, with an extraordinarily short tail (57–58% of the wing) and a rather short tarsus (25–26%). The bill is about halfway between *Poecilodryas* and *Peneothello*, neither compressed nor depressed. The wing formula is $4 = 5 = 6 > 3 = 7 > 8 > 9 = 2$, the first primary being 58% of the second. The general coloration is black with white on the upper tail-coverts, sides of breast and lower abdomen. No white on wing or tail. The juvenal plumage appears to be unknown. A specimen in the first-year plumage (Hompua, Huon Peninsula, April 8, 1929, R. H. Beck, ♂) shows a coloration totally different from that of any *Poecilodryas*, *Peneothello* (or *Saxicola*). It is sooty black all over, without white on the sides of the

breast, just with some white tips on crissum and under tail-coverts. There is no brown in the plumage, except for a brownish wash on some of the greater upper wing-coverts. The coloration of this first-year bird suggests that the juvenal plumage is largely sooty black or sooty brown.

MONACHELLA

This monotypic genus is very aberrant in structure and color characters, but is

probably, of all the Papuan genera, most closely related to *Microeca*. It agrees with that genus in the short tail (61–64% of the wing), in the weak foot and short tarsus (17–18.5% of the wing), and in the more or less spotted juvenal plumage (see Ibis, 1915, Suppl., p. 166). The wing formula is $4 > 3 = 5 > 6 > 2 > 7 > 8$ (pointed wing), and the first primary is about 38% of the second, the second primary being very long.

PARADISAEIDAE

NOTES ON *PHONYGAMMUS KERAUDRENII JAMESI* SHARPE

There is much confusion in the literature concerning the characters and range of this form. It is exceedingly close to typical *keraudrenii*, but differs by larger size and longer ear-tufts (Mayr and Rand, 1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 194). The tail-wing index is large as in *keraudrenii*; it is 76.3, 76.8, 77.7, 79.3,

80.5, 81.2, av. 78.6, in a series of six adult males from the Aru Islands and south New Guinea. Wing length, ♂ ad. 165, 166, 168, 169, 169, 169, against 156, 156, 157, 159, 159, 160, 161, 164 in *keraudrenii*.

RANGE.—Aru Islands; southern New Guinea from the Mimika River in the west, eastward at least to Hall Sound.

ON THE CORRECT NAME OF THE WEST NEW GUINEA KING BIRD OF PARADISE (*CICINNURUS REGIUS*)

When Ogilvie-Grant found in 1915 that *Cicinnurus regius* showed some geographical variation (Ibis, Suppl., p. 16) he took great pains to point out that Linnaeus' name should be applied to the Aru Island race, but he ignored that there were two additional names available which unquestionably refer to the western New Guinea race and antedate *claudii* Grant.

The older of these names is *Paradisaea Rex* Scopoli, 1788, Del. Faun. et Flor. Insubr., pt. 2, p. 88. Scopoli's name is exclusively based on Sonnerat's description (1776, Voy. Nouv. Guinée, p. 156, Pl. 95). It is now known that Sonnerat never reached New Guinea, but was anchored at Gebe, approximately 100 km. from New Guinea. There native traders brought him

the bird specimens which were subsequently described in his narrative. It is obvious that the *Cicinnurus regius* which he obtained at Gebe must have come from Batanta, Salawati or the Vogelkop and I, therefore, restrict the type locality of *rex* Scopoli to the Sorong district, western New Guinea.

Even if the name *rex* were rejected as being too similar to *regius* another unused name would have to replace *claudii*: *Cicinnurus spinturnix* Lesson (1835, Ois. Parad., p. 182, Pls. xvi–xviii). This name is based on a male and a female collected at Dorei (= Manokwari) by the Coquille Expedition. I, therefore, restrict the type locality of *spinturnix* to Manokwari, Vogelkop.

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CONTRIBUTION TO A REVISION OF NEOTROPICAL MYDAEINI (DIPTERA: MUSCIDAE)

By FRED M. SNYDER

This paper is a portion of a partially completed World revision of the Mydaeini. It was originally planned to publish the revision in its entirety, but because of present World conditions and the difficulties in obtaining material, these plans have had to be abandoned.

It was thought best to break it up into parts dealing with various faunal regions and present the various portions as availability of material permits. Later it is hoped to publish a key to the species of the World and a more complete discussion of genera and certain species as well as a catalogue of species.

For the present, new species will be described in the currently accepted genera unless it is obviously necessary to do otherwise. The present paper contains keys and descriptions of the Neotropical species of the genera *Helina* and *Mydaea* in the strictest sense, known to me at this time.

I wish to express my gratitude to the authorities of The American Museum of Natural History, Illinois Natural History Survey, United States National Museum and the Deutsches Entomologisches Institut, for the opportunity to study type as well as other specimens in their collections and to Dr. C. H. Curran and Mr. J. R. Malloch I am indebted for help and criticisms.

Mydaea ROBINEAU-DESVOIDY (*sensu stricto*)

ROBINEAU-DESVOIDY, 1830, Mem. Acad. Roy. Soc. France, II, p. 479.

The genus *Mydaea* in its strict sense includes species of Mydaeini having hairs on both surfaces of the node of the second and third wing veins and not beyond, pubescent to plumose arista and usually with hairs on the notopleura at the base of the notopleural bristles and, if the arista is dis-

tinctly plumose, there are usually setulae on the posterior ventral portion of the hypopleura above the hind coxae. In the four new species described herein, where visible, the ventral apical portion of the ovipositor bears distinct thorn-like bristles.

TABLE OF SPECIES

- 1.—Wings with a distinct costal cloud. . . . 2.
Wings without a distinct costal cloud . . . 3.
- 2.—With only a costal cloud; fore tibiae with a median posterior bristle; margins of calypterae not darkened *fumicosta*, n. sp.
With a distinct cloud on cross-veins and at apices of third and fourth veins; fore tibiae without a median posterior bristle; margins of calypterae dark brown to black *nubivena*, n. sp.
- 3.—Fore coxae black; margins of upper calypterae black; fore tibiae bare at middle; dorsocentrals 2:4 . . . *plummanni*, n. sp.
Fore coxae yellow; margins of upper calypterae pale; fore tibiae with one or two median posterior bristles; dorsocentrals 2:3. *meridia*, n. sp.

Mydaea fumicosta, new species

FEMALE.—7.5 mm. long. Parafacials, parafrontals and cheeks black with dense, slightly bluish-gray pruinescence. Front at vertex two-sevenths of head width, widened to one-third anteriorly. With a row of seven or eight parafrontal bristles, the posterior two pair outwardly, the others inwardly directed, with a few short setulae laterad all of them. The most anterior pair of parafrontals distinctly stronger than others, almost as strong as the ocellars. Junction of parafacials and parafrontals almost as long as greatest width of third antennal segment, parafacials narrowed to half the width of antennae below. Cheeks one and a half times as high as width of third antennal segment. Eyes bare. The head slightly higher and not as long as usual. Antennae inserted opposite dorsal fourth of eyes. Antennae and palpi black. Third antennal segment a little over three times as long as second. Longest hairs on arista about one and a fourth times as long as its greatest diameter.

Thorax black, slightly shiny, with sparse gray pruinescence, only indistinctly quadrivittate.

Presutural acrostical setulae in four to six irregular rows and a pair of prescutellar acrostical bristles; dorsocentrals 2:4; intra-alars 2; pra about half as long as posterior notopleural bristle, the latter with one or two setulae at base. Scutellar setulae very sparse, not descending below level of marginals. Sternopleurals 1:2; hypopleura and sternites bare.

Coxae, trochanters, tarsi and fore femora black, rest of legs fulvous except apices of mid and hind femora which are slightly brownish. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with two or three ventral bristles on basal half to third, a row of very weak anterior setulae on basal half, the most apical one or two in this series quite well developed and with a very weakly developed apical anterodorsal bristle. Mid tibiae with two median posterior bristles. Hind femora with three or four widely placed short anteroventral bristles on apical half to third. Hind tibiae with one median anterodorsal and anteroventral bristle.

Wings slightly broader than usual, brownish yellow, shiny hyaline, with an almost opaque deep brown to blackish cloud extending from apex of subcosta to apex of second vein and reaching slightly posterior to second vein. Cross-veins not infuscated. Costal setulae and thorns not distinctly developed. Node hairy above and below. Other veins bare. Penultimate portion of fourth vein five-sixths as long as ultimate. Third vein a little more bowed at middle than usual. Third and fourth veins subparallel at apices. Calyptrae white. Knobs of halteres dark brown to black, stalk fulvous.

Abdomen long and rather pointed, shiny, slightly greenish black pruinose, unspotted. Basal sternite bare. Ovipositor with short thorns on the last visible sternite but none on suranal plate.

HOLOTYPE.—Female, Hda Talahua, Prov. Bolivar (Ecuador), 3100 m., April 29, 1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.).

Fumicosta may be distinguished from the Bolivian species, *marginalis* Stein,¹ by the higher insertion of the antennae, mostly yellowish legs and the more basally extended costal cloud. I have not seen *marginalis* and it is impossible to say whether or not *marginalis* belongs to this group because of the great superficial resemblance of many species belonging to different genera.

Mydaea nubivena, new species

FEMALE.—7 mm. long. Parafrontals, ventral margins of cheeks and posterior half of

frontal vitta black, grayish pruinose, the parafrontals, rest of cheeks and frontal vitta fulvous, grayish pruinose. Occiput black, grayish pruinose. Front at vertex a little less than a third of head width (five-eighths), widened to one-third anteriorly. With a strong anterior parafrontal bristle, four to six pairs of very much shorter, inwardly directed and two pairs of moderately developed, outwardly directed bristles, with a row of very short setulae laterad of all parafrontal bristles. Juncture of parafrontals and parafrontals three-fourths as long as narrowest width of third antennal segment and half as wide as its greatest width; parafrontals obscured below. Cheeks one and a half times as high as greatest width of third antennal segment, with one or two rows of downwardly directed, very short setulae along lower margin. Eyes bare or with very short, sparse hairs. Palpi light brown to dark orange, most of the setulae very short and rather spine-like. Antennae light reddish brown; the base of third segment light fulvous. Third antennal segment two and three-fourths times as long as second, gradually narrowed apically. Longest arisal hairs three-fourths as long as greatest width of third antennal segment, and as long as narrowest width.

Thorax bluish black, with sparse bluish-gray pruinose and four very narrow, scarcely distinguishable vittae. Presutural acrostical setulae in ten to twelve irregular rows and a pair of prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra one-third as long as posterior notopleural bristle, the latter with several setulae at base. Scutellar setulae not descending below level of marginals. Sternopleurals 1:2; hypopleura and sternites bare.

Legs black, the knees brownish orange, the tibiae darker brown. Fore femora normal. Fore tibiae bare in the middle. Mid femora with three to five ventral bristles on basal half, without distinguishable basal or apical anterior bristles. Mid tibiae with two median posterior bristles. Hind femora with three or four long, widely spaced anteroventral bristles on apical half, a few very short but distinct anteroventral setulae on basal half and five or six posteroventral bristles on basal half. Hind tibiae with two anterodorsal and one anteroventral median bristles.

Wings very slightly grayish hyaline. Costal margin and cross-veins deeply infuscated, with a faint subconfluent cloud at apex of third and fourth veins; the cloud at apex of third vein grading into the faintly infuscated apical portion of costal cloud. Costal thorns and setulae undeveloped. Node hairy above and below. Other veins bare. Third and fourth veins subparallel at apices. Calyptrae white, the margins narrowly blackened. Knobs of halteres black, the stalk yellow.

Abdomen bluish black, subshiny, with sparse grayish pruinose, unmarked. Basal sternite bare; others with a pair of well-developed apical bristles. Ovipositor with strong spines below.

¹ Stein, 1918, Ann. Mus. Nat. Hung., XVI, p. 184.

TYPES.—Holotype, female, Baños (Ecuador), March 4, 1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.). Paratype, 1 female, near mouth Rio Mapiri (Bolivia?), September, Mumford Biological Expedition 1921-1922 (U. S. Nat. Mus.).

Mydaea trisetata Curran¹ will trace out to this species in the accompanying key, but since *trisetata* has a short but very distinct posteroventral bristle on apical third of hind tibiae, it is not included within the group of genera treated herein and I believe that it would be more properly placed among the Phaonini.

There are several neotropical species, *marginipennis* Stein and *vierecki*, new species, having the same rather bluish body coloring and wing markings as *nubivena*. This last species may be distinguished from both of them by the presence of notopleural hairs as well as the setulae on the node above and below.

Mydaea meridia, new species

FEMALE.—5.5 mm. long. Head black, the parafacials, parafrontals and cheeks yellowish gray pruinulent. Front at vertex slightly more than one-fourth of head width, distinctly widened anteriorly. Parafrontals with a complete row of bristles, the posterior two outwardly directed. Juncture of parafacials and parafrontals as long as width of third antennal segment at narrowest part, parafacials very much narrowed below. Cheeks as high as width of parafacials at base of antennae. Eyes bare. Palpi yellow. Second antennal segment and base of third to slightly below the insertion of arista yellowish orange, rest of third segment brownish. Third antennal segment three times as long as second. Longest hairs on arista about as long as its basal diameter.

Thorax black, grayish pruinulent with four moderately distinct brown vittae. Humeri slightly lighter in ground color than the rest of thorax. Presutural acrostical setulae in four or five irregular rows and a moderately well-developed pair of prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra not more than half as long as posterior notopleural bristle and slightly more than one-fourth as long as the bristle behind it; with only one or two very weak setulae at base of posterior notopleural bristle on one side. Scutellar setulae reaching to but not below level of marginals. Sternopleurals 1:2; hypopleura including the portion above hind coxae and sternites bare.

Legs yellow, only the tarsi and a very narrow

apical portion of mid and hind femora infuscated. Fore femora normal. Fore tibiae with one long and one short median posterior bristle. Mid femora with two or three short but moderately well-developed basal ventral bristles, bristles on basal half of anterior surface only slightly developed, with one apical anterior but no apical anterodorsal bristles. Mid tibiae with two median posterior bristles. Hind femora with three or four widely scattered bristles on apical half of anteroventral surface, and with two or three at base on posteroventral surface. Hind tibiae with two median anterodorsal and one anteroventral bristle.

Wings hyaline. Third and fourth veins strongly divergent at apices, distinctly curved. Costal thorns and setulae only slightly developed. Node with a few weak hairs above and below. Calyptrae white hyaline. Halteres yellow.

Abdomen slightly yellowish in ground color at base of first visible segment, rest of the dorsum black, slightly bluish gray pruinulent, with dorsal and lateral checkings. The ventral margins of the tergites and lateral margins of the sternites slightly yellowish. Basal sternite bare; others slightly longer than broad with only weak apical bristles. Ovipositor not distinctly visible, but the portion which can be seen is slightly yellowish with distinct spines.

HOLOTYPE.—Female, Coapa, D. F. (Mexico), August 26, 1922, E. G. Smyth coll. (U. S. Nat. Mus.).

This remarkable species should be at once recognizable by its three postsutural dorso-central bristles, yellowish undilated palpi, apically infuscated antennae and largely yellowish legs.

Mydaea plaumanni, new species

FEMALE.—7 mm. long. Head black, grayish pruinulent. Front at vertex one-fifth of head width, widened to one-fourth of head width anteriorly. Frontal vitta at middle about twice as wide as distance across posterior ocelli, inclusive; the parafrontals one-fourth as wide as width of frontal vitta, with a complete row of bristles, the most anterior one strongest and about as long as ocellars, the posterior two pairs outwardly and the others inwardly directed, all with setulae laterad of them in one or two irregular rows. Juncture of parafacials and parafrontals four-fifths as long as width of third antennal segment, parafacials narrowed to one-fourth its width below. Cheeks one and a fourth times as high as width of third antennal segment. Eyes with distinct, short, sparse hairs. Palpi rather uniformly broadened, blackish on basal and yellow on apical halves. Antennae black, root of third antennal segment reddish yellow. Third antennal segment three times as long as second. Longest arisal hairs about three-fourths to four-fifths as long as width of third antennal segment. When viewed in profile,

¹ Curran, 1931, American Museum Novitates, No. 492, p. 13.

the front distinctly retreating and the head distinctly higher and narrower than usual.

Thorax bluish black with dense bluish-gray pruinescence and four indistinct black vittae and with a faint median vitta extending from apex of scutellum to level of second dorsocentral. Presutural acrostical setulae in six to eight irregular rows and a distinct pair of prescutellar acrostical bristles; dorsocentrals 2:4; intralars 2; pra three-fourths as long as the short posterior notopleural bristle, but only one-fourth as long as the dorsocentral and supra-alar bristles; numerous hairs at base of notopleurals. Scutellar setulae reaching to but not below level of marginals. Sternopleurals 1:2; prosternum bare, the metasternum with a few setulae. Hypopleura with two or more setulae above base of hind coxae.

Legs black, the knees and tibiae dark yellowish. Fore femora normal. Fore tibiae bare in the middle. Mid femora with three to five ventral bristles on basal third to half, without basal anterior bristles but with an anterior setula. Mid tibiae with three median posterior bristles. Hind femora with a complete row of anteroventral bristles, those on basal half much shorter and more hair-like than those toward apex and with a few fine posteroventral setulae on basal half, the apical one in this series often most well developed. Hind tibiae with two or three anterodorsal and one anteroventral median bristles.

Wings glass hyaline, the anterior cross-veins very slightly infuscated. All veins deep black. Costal setulae and thorns undeveloped. Node hairy above and below, other veins bare. Third and fourth veins gradually divergent at apices. Discs of calyptrae concolorous with wing membrane but the margins darkened, the upper one most noticeably so. Halteres yellow to orange, the juncture of knob and stalk darker.

Abdomen bluish black, bluish gray pruinescent, with slight dorsal and distinct lateral checkerings. Basal sternite bare; others with one to three pairs of short, fine, apical bristles. With distinct thorns on suranal plate of ovipositor.

TYPES.—Holotype, female, Nova Teutonia (Brasil), 27°11' B., 52°23' L.,¹ June 6, 1939, Fritz Plaumann coll. (Amer. Mus. Nat. Hist.). Paratype, 1 female, topotypical (U. S. Nat. Mus.); 1 female, topotypical, November 10, 1937 (F. M. Snyder).

One paratype is quite teneral and lacks hairs on the metasternum but agrees in all other respects with the holotype. The very narrow front in the female should readily distinguish this species from all others placed in *Mydaea*, s.s. This character, as well as the metasternal hairs, might be considered

of generic value, but since the former is a sexual character and the latter apparently variable, I shall place it in *Mydaea*, s.s.

Helina ROBINEAU-DESVOIDY (*sensu stricto*)

ROBINEAU-DESVOIDY, 1830, Mem. Acad. Roy. Soc. France, II, p. 493.

This group of species discussed and described herein will run out to the group of *Helina* mentioned in the second alternative of the fifth couplet of the key in my paper on this genus.²

In several cases I have keyed out species in the following table which I have not seen but which I feel confident belong to this group. There are undoubtedly other species which would fall into this group but because there is a possibility that they might possess characters not mentioned by their describers which would exclude them from *Helina* (s.s.) I have not attempted to include them.

TABLE OF SPECIES

MALES

- 1.—With three pairs of strong postsutural dorsocentral bristles.....2.
With four pairs of strong postsutural dorsocentral bristles.....12.
- 2.—Costal margin, cross-veins and apex of veins broadly infuscated; stalk of halteres at base of knobs darkened; hind femora with fine, almost hair-like bristles on basal half or more of posteroventral surface.....3.
Wings not so marked or not as above *in toto*.....4.
- 3.—Frontal vitta at narrowest not more than one and a half times as wide as diameter of anterior ocellus; when viewed in profile, the antennae inserted opposite middle of eyes; the narrow third antennal segment not more than two and a half times as long as second... *vierecki*, n. sp.
Frontal vitta at narrowest almost two and a half times as wide as distance across posterior ocelli, inclusive; when viewed in profile the antennae inserted opposite dorsal third of eye; the broad third antennal segment almost four times as long as second... *marginipennis* (Stein).
- 4.—One or two pairs of strongly developed presutural acrostical bristles.....5.
With at most a pair of well-developed acrostical setulae which are never more than half as long and strong as the adjacent dorsocentrals, or eyes not separated by more than distance across posterior ocelli, inclusive.....6.

¹ Latitude and longitude.

² 1940, Amer. Mus. Novitates, No. 1080, p. 2.

- 5.—Eyes with short but distinct hairs; deep blackish pruinose species with only the apices of mid and hind femora orange-colored; hind tibiae with three anterodorsal bristles and three or four shorter posterior ones at middle. *rufoplicata* Malloch.
Eyes bare; light yellowish-gray pruinose species with at most only the fore femora indistinctly darkened; hind tibiae with only one anterodorsal and no posterior bristles. *acrosticalis*, n. sp.
- 6.—Longest arisal hairs shorter than or only as long as greatest diameter of arista. . . 7.
Longest arisal hairs at least half as long as the width of third antennal segment. . . 9.
- 7.—Palpi, second antennal segment and fore femora yellowish to fulvous. *acrinis*, n. sp.
Palpi, second antennal segment and fore femora black. 8.
- 8.—Hind tibiae with only one anteroventral bristle which is situated on the apical fourth. *xena* Malloch.
Hind tibiae with two or three anteroventral bristles which are situated on the apical two-thirds. *adelpa* (Schiner).
- 9.—Hind tibiae without a basal posterodorsal bristle; cross-veins very broadly infuscated; abdominal sternites without long marginal bristles. 10.
Hind tibiae with one or more posterodorsal bristles on basal half or more; cross-veins very narrowly infuscated; abdominal sternite with a marginal fringe of long bristles. *lastosterna*, n. sp.
- 10.—Hind femora with a complete row of antero- and posteroventral bristles or long bristly hairs. 11.
Hind femora with at most only the anteroventral bristles. *decora*, n. sp.
- 11.—A conspicuous dark spot at base of discal cell below juncture of second and third wing veins. *poeciloptera* (Schiner).
Only the cross-veins infuscated. *signatipennis* (v. d. Wulp).
- 12.—All legs black or very dark brown. 13.
At least some part of the legs much lighter colored. 15.
- 13.—Margins of upper calyptrae darkened; hind femora without posteroventral hair-like setulae or bristles. *browni*, n. sp.
Margins of upper calyptrae not darkened; hind femora with an almost complete row of posteroventral hair-like bristles or setulae. 14.
- 14.—Hind tibiae with a series of very long fine posteroventral and ventral bristles on basal three-fourths which are strongest at the base and become shorter toward apex. *longipila* (Stein).
Hind tibiae without long hair-like posteroventral and ventral setulae on basal three-fourths. *equator*, n. sp.
- 15.—With one or more pairs of distinct presutural acrostical bristles which are always stronger than the adjoining acrostical setulae. 16.
With only presutural acrostical hairs or setulae. *copiosa* (v. d. Wulp).
- 16.—Fourth wing-vein strongly deflected posteriorly at apex; posterior cross-vein strongly curved; both cross-veins broadly infuscated. *inepta* (Stein).
Fourth wing-vein not strongly deflected posteriorly at apex; other characters not as above *in toto*. 17.
- 17.—Mid tibiae with a strong median posteroventral bristle; front distinctly wider than width of third antennal segment; pra less than one-third as long as bristle behind it. 18.
Mid tibiae with no posteroventral bristles or if present the other characters are not as above *in toto*. 20.
- 18.—Longest hairs on arista not longer than its greatest diameter; mid tibiae with one or two submedian anterodorsal bristles. *discolor* (Stein).
Longest hairs on arista distinctly longer than its greatest diameter. 19.
- 19.—Mid tibiae with no anterodorsal bristles; scutellar setulae descending below level of marginals. *chilensis* Malloch.
Mid tibiae with one or two anterodorsal bristles; scutellar setulae not descending below level of marginals. *simplex* Malloch.
- 20.—All femora and tibiae entirely fulvous. *dubia* (Bigot).
At least some part of femora or tibiae infuscated. 21.
- 21.—Pra at most not more than one-third as long as first postsutural dorsocentral bristle. 22.
Pra as long and strong as the first postsutural dorsocentral bristle. 25.
- 22.—Hind femora and the tibiae at base with long, slender posteroventral bristles. *longipila* (Stein).
Hind legs not so armed. 23.
- 23.—Front at narrowest equal to length of third antennal segment; parafacial bristles extending all the way to vertex. *rufoplicata* Malloch.
Front at narrowest not nearly as wide as length of third antennal segment; at most only slightly wider than distance across posterior ocelli, inclusive. 24.
- 24.—Mid tibiae without one or two median anterodorsal bristles; hind femora and tibiae darkened only on basal fourth. *townsendi*, n. sp.
Mid tibiae with one or two median anterodorsal bristles; hind femora darkened on basal half and the hind tibiae darkened on basal two-thirds. *fulvocalyptata* Malloch.
- 25.—Longest arisal hairs fully one-half as long as width of third antennal segment; the hair-like anteroventral bristles on hind femora not as long as diameter of femora

- where situated; legs mostly blackish. *bigoti* Malloch.
- Longest hairs on arista not longer than its greatest diameter; the hair-like bristle on hind femora at least one and a half times as long as diameter of femora where situated; legs mostly yellow. 26.
- 20.—Mid tibiae with one or more short but distinct submedian anterodorsal bristles; femora and tibiae yellow; hind femora with a number of long, hair-like posteroventral bristles which are distinctly longer than diameter of femora where situated. *connera* Malloch.
- Mid tibiae anterodorsally bare; hind femora without long, hair-like posteroventral bristles. 27.
- 27.—Mid and hind femora entirely yellow. *bifimbriata* Malloch.
- Basal two-thirds of mid and hind femora blackened; abdominal pruinescence gray. *bifimbriata* var. *grisea* Malloch.
- Basal one-third or less of mid and hind femora darkened; abdominal pruinescence golden brown. *bifimbriata* var. *basilis* Malloch.
- FEMALES
- 1.—With three pairs of strong postsutural dorsocentral bristles. 2.
- With four pairs of strong postsutural dorsocentral bristles. 13.
- 2.—Cross-veins, costal margins and apex of third and fourth wing-veins broadly infuscated; no prescutellar acrostical bristles; pra absent; halteres black. *marginipennis* (Stein).
- At most only the cross-veins infuscated or not as above *in toto*. 3.
- 3.—Hind tibiae with one or more distinct posterodorsal bristles on basal half or less. 4.
- Hind tibiae posterodorsally bare. 7.
- 4.—Frontal vitta with a pair of cruciate bristles; cheeks almost half as high as eye; fore tibiae without median posterior and anterodorsal bristles; pra almost as long and strong as posterior notopleural bristles. *cruciata*, n. sp.
- Frontal vitta without cruciate bristles; cheeks less than one-fourth of eye height; fore tibiae with either a posterior or anterodorsal median bristles or with both. 5.
- 5.—Second antennal segment mostly or entirely light yellow to orange. *parvula* (v. d. Wulp).
- Second antennal segment entirely black or dark brown. 6.
- 6.—Hind tibiae with two or three posterodorsal bristles; longest arisal hairs not quite as long as greatest width of third antennal segment. *copiosa* (v. d. Wulp).
- Hind tibiae with only one posterodorsal bristle on basal third or less; longest arisal hairs not over half as long as greatest width of third antennal segment. *canoe*, n. sp.
- 7.—Aristal hairs at most only slightly longer than the greatest diameter of arista. 8.
- Aristal hairs distinctly longer than greatest diameter of arista, usually at least half as long as greatest width of third antennal segment. 12.
- 8.—Thorax, abdomen and palpi largely or entirely yellow in ground color; fore tibiae with a median anterodorsal bristle. *arctis*, n. sp.
- Thorax entirely and the abdomen and palpi usually black; fore tibiae without a median anterodorsal bristle. 9.
- 9.—Mid tibiae with two median anterodorsal bristles. *brevivena*, n. sp.
- Mid tibiae without median anterodorsal bristles. 10.
- 10.—With one or more pairs of short but distinct presutural acrostical bristle-like setulae; cross-veins very broadly infuscated. 11.
- Without presutural acrostical bristles; cross-veins at most only moderately infuscated. *socia* (v. d. Wulp).
- 11.—Mid and hind femora infuscated on apical third, the basal two-thirds orange-yellow; hind tibiae with only one anteroventral bristle which is situated on apical fourth. *xena* Malloch.
- All femora almost entirely infuscated; the anteroventral hind tibial bristle situated at middle. *adelpa* (Schiner).
- 12.—First and second longitudinal veins, cross-veins and fourth vein at base of discal cell broadly infuscated; cross-veins most distinctly so; sternopleurals 1:2. *poeciloptera* (Schiner).
- Only the cross-veins infuscated; sternopleurals 2:2. *decora*, n. sp.
- signatipennis* (v. d. Wulp).
- 13.—Metallic violet-blue non-pruinescent species with entirely black calyptrae and halteres. *viola* Malloch.
- Species not so colored. 14.
- 14.—Legs entirely black to dark brown. 15.
- Legs partly or entirely yellow to reddish. 17.
- 15.—Margins of both calyptrae and the entire halteres black; scutellar setulae descending well below level of marginals; especially at base of scutellum; abdomen distinctly bluish, with sparse grayish pruinescence. *notha*, n. sp.
- Margins of calyptrae and entire halteres not black; at most with one or two setulae descending below level of marginals at middle of scutellum. 16.
- 16.—Posterior cross-vein joining the fourth vein at about the middle of the portion beyond the anterior cross-vein; costal cell basad the first vein light brownish hyaline, scarcely darker than the lightest portion of wing-membrane. *anubes*, n. sp.

- Posterior cross-vein joining the fourth vein well beyond the middle of the portion beyond anterior cross-vein; costal cell before juncture basad first vein almost opaque, black, very much darker than the lightest portion of wing-membrane.....*equator*, n. sp.
- 17.—Mid tibiae with a submedian posteroventral bristle.....*simplex* Malloch.
Mid tibiae without a submedian posteroventral bristle.....18.
- 18.—Mid tibiae with two or more strong median anterodorsal bristles.....19.
Mid tibiae bare or with a single very weak median anterodorsal bristle.....21.
- 19.—Pra as long as or longer than the posterior notopleural bristle; mid and hind femora entirely yellow.....*connexa* Malloch.
Pra not more than half as long as the posterior notopleural bristle.....20.
- 20.—Thorax with dense, golden-yellow pruinescence; all tibiae fulvous; without a strong pair of prescutellar acrostical bristles.....*brevinena*, n. sp.
Thorax with grayish pruinescence; only the hind tibiae reddish, rest of legs black; with a pair of strong prescutellar acrostical bristles....*fulvocalyptata* Malloch.
- 21.—Fourth vein very strongly curved posteriorly at apex; cross-veins broadly infuscated, the posterior one most broadly so at its juncture with fourth and fifth veins; eyes with short but distinct hairs.....*inepta* (Stein).
Fourth vein subparallel with the third at apex; cross-veins not broadly infuscated.....22.
- 22.—Mid and hind femora entirely yellow....*bifimbriata* Malloch.
Mid and hind femora mostly infuscated...23.
- 23.—Pra distinctly longer than the posterior notopleural bristle; mid tibiae with four or five median posterior bristles; fore and mid tibiae entirely fulvous.....*bigoti* Malloch.
Pra not over half as long as the posterior notopleural bristle; mid tibiae with two median posterior bristles; fore and mid tibiae entirely infuscated...*anubis*, n. sp.

Helina marginipennis (Stein)

Spilogaster marginipennis STEIN, 1904, Ann. Mus. Nat. Hung., II, p. 440.

Mydaea marginipennis STEIN, 1911, Archiv f. Nat., Abt. A, heft 1, LXXVII, p. 24.

MALE.—7 mm. long. Head black, grayish pruinose. Juncture of parafacials and parafrontals and cheeks near facial ridges with a slightly reddish cast. Front at narrowest point almost twice as wide as distance across posterior ocelli, inclusive. At the same level, the parafrontals as wide

as diameter of anterior ocellus. With one well-developed and one somewhat weaker parafrontal bristle and two setulae on anterior third, rest of parafrontal bare. Juncture of parafacials and parafrontals almost as long as the broadened third antennal segment, parafacials almost obscured below. Cheeks almost as high as width of third antennal segment. Eyes with very short, sparse, scarcely distinguishable hairs. Antennae and palpi black, the former inserted opposite the dorsal third of eye. Third antennal segment greatly elongated and broadened, four times as long as second extending well below lower margin of eyes and to the oral margin. Longest hairs on arista scarcely longer than its greatest diameter.

Thorax bluish with grayish pruinescence and four narrow vittae. Presutural acrostical setulae in four moderately regular rows, the outer row most well developed and with a pair of moderately well-developed prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra absent. Scutellar setulae rather sparse, not descending below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs black, the apices of femora and the middle of the tibiae somewhat dirty brown. Fore femora normal. Fore tibiae with a strong median posterior bristle. Mid femora with two or three short basal ventral bristles and a row of anterior bristles on basal half as well as a well-developed subapical anterior and anterodorsal bristle. Mid tibiae with two median posterior bristles. Hind femora with four or five widely spaced short anteroventral bristles and a series of somewhat longer but more hair-like posteroventral setulae on basal half or less. Hind tibiae with one median anterodorsal, one median anteroventral and one additional anteroventral bristle on apical fourth.

Wings hyaline, the costal margin from apex of subcosta to wing-tip extending slightly posteriorly to the second longitudinal vein and joining a large round spot around anterior cross-vein, the posterior cross-vein, apex of third wing-vein and a limited subapical portion of the fourth vein

brownish infuscated. Costal setulae and thorns undeveloped. All veins bare; third and fourth slightly divergent at apices. Calyptrae white. Halteres brown, the portion of the stalk at base of knob darkened.

Abdomen bluish with dense whitish pruinescence and with a pair of subconfluent subtriangular black spots on second and third visible tergites. The abdomen rather elongated and narrowed apically. Basal sternite bare; others distinctly longer than wide, with a pair of very well-developed apical bristles; fifth distinctly cleft, the armature not visible. Hypopygium concolorous with rest of abdomen.

FEMALE.—8 mm. long. Similar to the male, differing from it in having the front at vertex not quite one-third of head width, slightly widened anteriorly, with several setulae laterad the two anterior parafrontal bristles and with none adjacent the two outwardly directed posterior ones. Prescutellar acrostical bristles absent. Mid femora with only the apical anterior bristle and hind femora with the median third of anteroventral surface bare. Wings with the clouds at apices of third and fourth veins more distinct and with the costal cloud reaching almost to the humeral cross-veins. Abdomen without as distinct subtriangular spots.

SPECIMENS EXAMINED.—1 male and 1 female from Huascaray Ridge, Pr. Jean, Peru, 7000 ft., September 21, C. H. T. Townsend coll. (in U. S. Nat. Mus.). The female bears the label in Townsend's handwriting "this acalyptrate seems to be counterfeited by predatory Tachs or visa versa."

Stein mentions that he had seen a pair of this species determined by Schiner as *lingindii*. I have been unable to find any reference to a species of this name described by Schiner and assume that it was a manuscript name.

See also discussion under *vierecki*, new species.

Helina vierecki, new species

MALE.—7 mm. long. Very similar to *marginipennis* Stein. Head colored as in *marginipennis*. Front at narrowest about as wide as distance across posterior ocelli, inclusive. At

the same level the frontal vitta one and a fourth times as wide as diameter of anterior ocellus and each parafrontal about half the width of vitta. Parafrontals with three to four pairs of bristles and two or three setulae which reach one-third the distance to anterior ocellus. Junction of parafacials and parafrontals as long as greatest width of the narrowed third antennal segment. At narrowest, parafacials as long as greatest diameter of arista. Cheeks one and a third times as high as width of third antennal segment. Eyes bare. Antennae inserted opposite the middle of the eyes and reaching only to the lower level. Third antennal segment two and a half times as long as second. Longest hairs on arista not more than twice as long as its greatest diameter.

Thorax more greenish blue with grayish pruinescence, and four darker narrow vittae. Presutural acrostical setulae in two irregular rows; pra about one-third as long as posterior notopleural bristle, otherwise as in *marginipennis*.

Legs very dark brown to black, the tibiae slightly lighter brown. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora as in *marginipennis* except the ventral bristles are longer than the anterior ones and only one subapical bristle which is anteriorly placed. Mid tibiae with two median posterior bristles. Hind femora with a complete row of seven or eight closely placed anteroventral bristles and a more compact row of posteroventral hair-like setulae.

Wings, calyptrae and halteres as in *marginipennis*.

Abdomen black, with very dense, brownish to clay-colored pruinescence, with a pair of slender spots on second and a shorter pair on third visible tergite. Otherwise as in *marginipennis*.

TYPES.—Holotype, Male, La Cumbee, Colombia, 7000 ft., December 15, 1922, H. L. Viereck coll.; paratype, 1 male, Vista Nieve, Colombia, December 16, 1922, H. L. Viereck coll. Both types bear C. H. Curran collection Acc. No. 31,144.

It is quite difficult to decide which of these two species represents Stein's *marginipennis*, since it was originally described on the basis of a female. The female which I take to be *marginipennis* agrees with all the characters mentioned by Stein, and the male which I associate with it, while having prescutellar acrostical bristles, also has the antennae inserted well above the middle of the eyes. For this reason I shall consider the male before me which has the broad third antennal segment and wider front as *marginipennis*, while the less bluish species with shorter and narrower

third antennal segment and narrow front as *vierecki*, new species. The paratype agrees in all respects with the above description except that it lacks the slender median anteroventral bristle on hind tibiae.

Helina cruciata, new species

FEMALE.—10 mm. long. Head black, densely silvery gray pruinulent, the cheeks and juncture of parafacials and parafrontals with slightly darker reflections. Front at vertex one-third of head width, widened anteriorly. With a complete row of parafrontal bristles, last two outwardly directed and numerous well-developed setulae on both sides of the bristles, those on the inner side being slightly less numerous but extending onto the frontal vitta, and with a pair of cruciate bristles. Juncture of parafacials and parafrontals one and a half times as long as greatest width of third antennal segment; parafacials distinctly narrowed below, but the broadened facial ridges make the parafacial appear not widened. Cheeks as high as length of third antennal segment and three-fifths of eye height. Facial ridges very much broadened, especially at lower level of eyes, at this level, slightly wider than width of third antennal segment and with numerous setulae especially on the lateral margin which reach slightly above level of the apex of third antennal segment. Eyes with distinct, short, sparse hairs. Palpi black. Apex of second antennal segment narrowly brownish to orange, rest of the antennae black. Third antennal segment three times as long as second, extending distinctly below level of lower margin of eyes. Longest arisal hairs three-fourths as long as width of third antennal segment.

Thorax black, densely whitish gray pruinulent, with four distinct brown vittae and with a spot at base of scutellum which joins a median dorsocentral vitta which extends anteriorly on the mesonotum slightly posterior to the transverse suture. The ventral surface of scutellum shiny brown and the margins slightly orange colored. Presutural acrostical setulae in six to eight irregular rows and with one or two pairs of well-developed prescutellar acrostical bristles; dorsocentrals 2:4; intra-alars 2; pra three-fourths as long as posterior notopleural bristle and about half as long as the bristle behind it and the anterior postsutural dorsocentral bristle. Scutellar setulae not descending below level of marginals. Sternopleurals 1:2; hypopleura and sternites bare.

Legs black, the tibiae slightly orange and with quite distinct whitish-gray pruinescence which in certain lights makes them appear concolorous with the femora. Fore femora normal. Fore tibiae bare in the middle. Mid femora with a row of ten to twelve quite short, bristle-like setulae on basal half of ventral surface and with a much weaker and scarcely distinguishable row of setulae on basal half of anterior surface,

no apical bristles on anterior surfaces. Mid tibiae with two median posterior bristles. Hind femora with a complete row of anteroventral bristles which are distinctly more well developed on apical half but none except the subapical one or two are longer than height of femora where situated and with a row of short, but distinct setulae on basal half of posteroventral surface. Hind tibiae with two median anterodorsal, posterodorsal and two or three anteroventral bristles.

Wings very faintly yellowish hyaline, especially along longitudinal veins. Cross-veins distinctly infuscated. Costal setulae and thorns undeveloped. All veins bare. Third and fourth veins distinctly divergent at apices.

Calyptrae white, halteres especially the knobs dark brown.

Abdomen black, densely whitish gray pruinulent, with a distinct dorsocentral vitta and subtriangular black spots on second visible tergite, which are confluent at their base; with a narrow transverse black band and with similar but less distinct markings on third visible tergite, the last tergite with a median triangular spot which joins the dorsocentral vitta and when viewed from the side with distinct lateral checkerings.

HOLOTYPE.—Female, Nogales, Arizona, June 25, 1933, Jean Russell coll. and bearing a label: *Helina*, n. sp., determined by D. G. Hall (U. S. Nat. Mus.).

I placed this very interesting species in *Helina* with some doubt, but it might be almost made the genotype of another genus because of the cruciate frontal bristles. This character is to be found among the Mydæini only in the genus *Myospila*, but here the fourth wing-vein is distinctly curved forward at apex and the node is hairy above and below, characters which are not exhibited by this species. However, I hesitate in doing any more than describing this species, since the male is unknown and quite possibly might not exhibit any peculiar characters other than proportional cheek, parafacial and facial ridge width.

This species is included in this paper as it is quite likely that it might be found farther South.

Helina lasiosterna, new species

MALE.—8.5 mm. long. Head black with dense silvery-white pruinescence. Front at narrowest point slightly wider than the distance across posterior ocelli, inclusive. The frontal vitta twice as wide as diameter of anterior ocellus and each parafrontal almost as wide as diameter of ocellus. With seven or eight pairs

of parafrontal bristles and setulae reaching to narrowest part of front. Juncture of parafacials and parafrontals one- and two-tenths times as long as width of third antennal segment and parafacials narrowed to about half its width below. Cheeks twice as high as width of third antennal segment, with a few upwardly directed setulae along lower margin. Eyes bare. Palpi yellowish brown on basal three-fourths, infuscated on apical fourth. Antennae black, third segment almost two and a fourth times as long as second. Longest arisal hairs as long as or slightly longer than the width of third antennal segment.

Thorax black, yellowish gray pruinose, with four distinct brown vittae. Presutural acrostical setulae in four to five irregular rows and a pair of weak prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra absent. Scutellar setulae reaching to, but not below, level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

All coxae black with slight variable brownish markings, trochanters brownish, fore femora darkened except at knees, mid and hind femora blackened on basal half to three-fourths, rest of femora yellow, all tibiae yellowish orange; fore tarsi yellow, only the first segment darkened, mid and hind tarsi with only the apical two or three segments yellowish, rest of segments black. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with three or four strong ventral bristles on basal half, the anterior bristles fine but distinct, limited to basal third and no apical bristles on anterior surfaces. Mid tibiae with two median posterior bristles. Hind femora with five or six anteroventral bristles on apical half. Hind tibiae with three median anterodorsal bristles, the middle one longest and strongest, three long anteroventral bristles, the middle one longest and strongest, three long anteroventral bristles on apical half, a distinct posterodorsal bristle on basal fourth and one or two short median posterior setulae.

Wings slightly yellowish-brown hyaline. Cross-veins no more infuscated than longitudinals. Costal setulae and thorns undeveloped. Third and fourth veins slightly divergent at apices. All veins bare. Calyptae and halteres pale yellow.

Abdomen black, yellowish gray pruinose, with a pair of brown spots on second and third visible tergites. Basal sternite with a few setulae; second about twice as long as broad, with about four long bristles on lateral margin of posterior half to one-third, these bristles about three-fourths as long as length of the sternite; third and fourth distinctly wider than long, with a complete row of very long bristles along lateral margins, these bristles fully as long as width of the sternite; fifth almost heart-shaped, with a deep but very narrow cleft and three short, stout bristles, one at middle of cleft on inner surface, the other two on apical half of disc. Hypopygium black.

TYPES.—Holotype, male, Las Visayas, Chic. (Mexico), August 27, 1909, C. H. T. Townsend coll. (U. S. Nat. Mus.); paratype, 1 male, Horseshoe Canyon, Chiricahua Mt., Arizona (U. S. A.), 6000 ft. (U. S. Nat. Mus.).

The paratype lacks the apical four abdominal segments, but the basal and second abdominal sternite as well as other characters indicate that the two specimens are conspecific.

Helina caneo, new species

FEMALE.—7 mm. long. Head black, densely grayish pruinose, the grayish pruinose frontal triangle extending three-fourths the distance to base of antennae. Frontal vitta velvety black with sparse grayish pruinoscence. Front at vertex one-third of head width, scarcely widened anteriorly. Each parafrontal one-third of frontal vitta width, with a complete row of parafrontal bristles, the anterior five inwardly directed, the posterior two outwardly directed and with a few rather long setulae below level of the anterior three or four parafrontal bristles. Juncture of parafacials and parafrontals four-fifths as long as length of antennae or three times as long as width of third antennal segment, parafacials narrowed to one and a half times the width of third antennal segment. Cheeks as high as juncture of parafacials and parafrontals. Eyes bare. Third antennal segment black, second and palpi dark brown. Third antennal segment one and two-thirds times as long as second. Longest arisal hairs half as long as width of third antennal segment.

Thorax black, densely grayish pruinose, with four brown vittae. Presutural acrostical setulae in three or four irregular rows and a pair of weak prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra absent. One or two scutellar setulae reaching slightly below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Coxae, fore femora, tarsi and a limited basal portion of mid and hind femora infuscated, rest of legs including trochanters fulvous. Fore femora normal. Fore tibiae with a strong median posterior bristle. Mid femora with one stout ventral bristle on basal fourth and a few very weak setulae beyond, with a row of slender anterior bristles on basal half and an apical anterodorsal bristle. Mid tibiae with three median posterior bristles. Hind femora with three long anteroventral bristles on apical third and about six to eight shorter setulae on basal two-thirds. Hind tibiae with three anterodorsal and three to four anteroventral bristles and a distinct posterodorsal bristle on basal fourth.

Wings brownish hyaline, cross-veins slightly infuscated. Costal setulae and thorns moder-

ately well developed. All veins bare. Third and fourth veins slightly divergent at apices, both slightly bent posteriorly. Calyptrae white, margined with pale yellow. Halteres pale yellowish orange.

Abdomen black, densely grayish pruinose, with a pair of small, brown spots on first and a pair of much larger ones on second and third visible tergites, fourth with a small central median brown vitta and the discal bristles inserted in brown spots. Basal sternite bare; others with a pair of very short, fine apical setulae.

HOLOTYPE.—Female, Mexico City, 10,000 ft., July, 1936, H. G. Meyer coll. (Amer. Mus. Nat. Hist.).

It may be possible that this is the female of the preceding species, *lasiosterna*, but I do not describe it as such because it seems probable that the female of *lasiosterna* would have similarly colored tarsi, if not entirely fulvous. On the other hand, it is difficult to theorize on what a specimen should look like.

Helina copiosa (v. d. Wulp)

Spilogaster copiosa VAN DER WULP, 1896, Biol. Cent. Amer., II, p. 321.—MALLOCH, 1921, Ent. News, XXXII, p. 43.

Additional chaetotaxic notes based on cotype male and female specimens in Illinois Natural History Survey collection and not included in either above references follow:

Frontal vitta at narrowest one and a half times as wide as diameter of anterior ocellus. Longest hairs on arista three-fourths as long as greatest width of third antennal segment. Dorsocentrals 2:4; the second posterior one weak; intra-alars 2; pra two-thirds as long as posterior notopleural bristle; sternopleurals 2:2, lower anterior one weak. Hypopleura and sternites bare.

Fore femora normal. Fore tibiae with a median posterior bristle. Mid tibiae with no anterodorsal and three median posterior bristles. Hind femora with about six anteroventral bristles on apical two-thirds. Hind tibiae with two to three anterodorsal and anteroventral median bristles and a distinct bristle on basal third of postero-dorsal surface.

Stein¹ was in error when he recorded this

¹ Stein, 1920, Archiv f. Nat., (A-9), LXXXIII, p. 1920 (*Mydaea*).

species from Indiana, U. S. A. His specimens, now in the U. S. Nat. Mus., were *nigribasis* Malloch.

Helina parvula (v. d. Wulp)

Spilogaster parvula VAN DER WULP, 1896, Biol. Cent. Amer., II, p. 321.—MALLOCH, 1921, Ent. News, XXXII, p. 43.

The single female cotype specimen from Tepetlapa, Guerrero, Mexico, 3000 ft., October (H. H. Smith), in the Illinois Natural History Survey collection, is quite teneral. The only distinct characters worthy of note at this time and not mentioned by either v. d. Wulp or Malloch follow:

Longest hairs on arista three-fourths as long as width of third antennal segment. Thorax bristled as in *copiosa* v. d. Wulp.

Fore tibiae with two median posterior bristles. Mid tibiae with no anterodorsal but with three posterior bristles. Hind femora with one strong subbasal anteroventral and four stronger ones on apical third.

Helina socia (v. d. Wulp)

Leucomelina socia VAN DER WULP, 1896, Biol. Cent. Amer., II, p. 326.—MALLOCH, 1921, Ent. News, XXXII, p. 42.

Additional descriptive notes follow:

Longest arisal hairs not as long as greatest diameter of arista. Dorsocentrals 2:3; intra-alars 2; pra one-fifth as long as bristle behind it; sternopleurals 1:2.

Fore femora normal. Fore tibiae with a median posterior bristle. Mid tibiae with two posterior bristles. Hind femora with a complete row of anteroventral bristles, those on basal half shortest. Hind tibiae with one median anterodorsal and three to five shorter anteroventral median bristles.

SPECIMENS EXAMINED.—1 female cotype, Illinois Natural History Survey collection, Omilteme, Guerrero, Mexico, 8000 ft., July (H. H. Smith).

Helina rufoapicata Malloch

MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 310.

I have seen only the holotype in the U. S. National Museum.

Helina acrinis, new species

MALE.—7 mm. long. Head brownish to reddish, densely silvery gray pruinose, frontal vitta brownish to brownish red. Front at narrowest point one and a fourth times as wide as distance across posterior ocelli, inclusive. Frontal vitta and parafrontals at same level one and a half to two times as wide as diameter of anterior ocellus. With only two or three moderately strong parafrontal bristles and with a few additional setulae which are confined to anterior fourth to third of front. Juncture of parafacials and parafrontals almost as long as width of third antennal segment, parafacials narrowed to half the width below. Cheeks about as high as width of third antennal segment. Eyes bare or with a very few scattered microscopic hairs. Palpi yellow to brown, the apices sometimes slightly darkened. Second antennal segment yellow to orange-brown, the third black, one and eight-tenths times as long as second. Longest hairs on arista at most one and a fourth times as long as its greatest diameter.

Thorax fulvous, the dorsum and mesopleura slightly grayish yellow, with indistinct grayish-white pruinescence and four moderately distinct light brown vittae. Presutural acrostical setulae in one or two irregular rows, often with one or two more well-developed setulae which are at most one-fourth to one-fifth as long as the first presutural dorsocentral bristles and a pair of distinct prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra short, not more than one-third to a half as long as posterior notopleural. Scutellar setulae very sparse, not reaching to level of marginals. Sternopleurals 2:2, the lower anterior one much weaker and occasionally absent; hypopleura and sternites bare.

Legs except tarsi yellow, tarsi brownish. Fore femora normal. Fore tibiae with one weak median anterodorsal and one stronger posterior bristles. Mid femora with five or six ventral bristles on basal half and two or three anteroventral setulae on basal two-fifths, a row of stronger anterior setulae on basal half and an apical anterior to anterodorsal bristle. Mid tibiae with two median posterior bristles. Hind femora with a complete row of anteroventral bristles which are about as long as height of femora where situated and a row of five posteroventral hairs or setulae on basal half. Hind tibiae with one median anterodorsal and two much weaker anteroventral bristles on apical third.

Wings yellowish hyaline. Cross-veins, especially the anterior one, pale brownish clouded. Costal thorns and setulae scarcely developed. All veins bare. Third and fourth veins subparallel. Calyptrae and halteres pale yellow.

Abdomen yellow, concolorous with the thorax, the sides of third and apices of fourth visible tergites at base grayish brown, with a pair of yellowish-brown spots on second and third visible tergites; third and fourth with an indistinct grayish dorsocentral line, the bristles and

setulae inserted in slightly darker yellowish to brownish spots. Basal sternite bare; others distinctly longer than broad, with a distinct pair of apical bristles; fifth moderately cleft, with two or three moderately distinct bristles on base of processes. Hypopygium yellow.

FEMALE.—Very similar to the male, differing from it in having the front at vertex one-third of head width, only slightly wider anteriorly. With a complete row of parafrontal bristles, the posterior pair outwardly and the anterior ones inwardly directed. Hind femora with the posteroventral hairs scarcely distinguishable and the basal anteroventral bristles shorter and less well developed than those on apical half. Abdominal spots less and the dorsocentral vitta more distinct. The basal and apical lateral darkening of tergites less distinct.

Types.—Holotype, male, Chosica (Peru), 3000 ft., December 6, 1913, on foliage (U. S. Nat. Mus.); allotype, female, topotypical, September 13, 1913 (U. S. Nat. Mus.); paratypes, 2 males and 1 female, topotypical; all collected by C. H. T. Townsend.

In addition to these specimens there are 2 males and 3 females from Peru, South America, 1913, H. A. Parrish coll., 1 female, Matucana, Peru, April 22, 1914, C. H. T. Townsend coll., and 1 female, Baños, Tungurahua, Ecuador, October 25, 1937, Clark-McIntyre, before me now which agree in all structural characters with the type series.

They differ in having the parafacials, parafrontals, cheeks and frontal vitta black in ground color. Only the humeri and scutellum are yellow and the former rather indistinctly so. The abdomen is darker, only the basal tergite, the ventral portion of tergites and the sternites yellow, the tergites more distinctly spotted.

They may represent a distinct variety or species but, since the difference is in color, I prefer to treat them as the same species but do not include them in the type series.

Dr. Aldrich had determined these specimens as *adelpha* Schiner, with a question. If I have identified *adelpha* Schiner correctly, it may be distinguished from *acrinis* by the possession of a much wider front, more broadly infuscated cross-veins, more distinct costal setulae and thorns and only a partial row of anteroventral bristles on apical half of hind femora. In addition,

adelpha has only the tibiae and the base and apices of mid and hind femora dark yellow. The abdominal spots are also much larger and distinctly subsquare in *adelpha*.

Helina acrosticalis, new species

MALE.—6.5 to 7 mm. long. Quite similar to *acrinis*, new species. Head black, slightly brownish gray pruinose, the cheeks with faint reddish reflections. Front at narrowest point two and a fourth times as wide as distance across posterior ocelli, inclusive. The black frontal vitta at narrowest one and a half times as wide as distance across posterior ocelli, inclusive, and the parafrontals at the same level about as wide as distance between the posterior ocelli, exclusive. Parafrontal bristles as in *acrinis*. Juncture of parafacials and parafrontals not quite as long as width of third antennal segment, parafacials narrowed to about half its width below. Cheeks as high as width of third antennal segment. Eyes bare. Palpi and second antennal segment orange-brown, third antennal segment black, only one and six-tenths times as long as second, slightly broader than in *acrinis*.

Thorax brownish black, brownish gray pruinose, with four rather indistinct brownish vittae. With one or two pairs of presutural acrostical bristles which are half as long as first presutural dorsocentral bristle and with one or two pairs of weaker bristles or setulae in front of the usual prescutellar pair of acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra one-third as long as posterior notopleural bristle. With only about six to eight short, scutellar setulae, the center of scutellar disc usually bare. All thoracic setulae slightly longer and sparser than usual. Sternopleurals 2:2; hypopleura and sternites bare.

Fore femora slightly infuscated, tarsi black, rest of the legs yellow. Bristled as in *acrinis* except the hind femora with longer and more slender anteroventral bristles and posteroventral setulae, and with the posteroventral setulae longer and covering the basal two-thirds to three-fourths.

Wings as in *acrinis*.

Abdomen entirely black, with dense brownish-gray pruinescence, a pair of round, brown spots on second and a less distinct pair on third visible tergites. Basal sternite bare; others including fifth as in *acrinis* except they also are black. Hypopygium dark brown to black.

TYPES.—Holotype, male, Quito, Ecuador, 2850 ft., F. Campos coll. (U. S. Nat. Mus.); paratype, 1 male, topotypical.

Helina xena Malloch

MALLOCH, 1934, Dipt. Pat. Soc. Chile, pt. VII, fasc. 2, p. 305.

Besides the two paratype males from Bariloche and Casa Pangué, Chile, in the U. S. National Museum, I have seen a female from Angol, Chile, August 21, 1934 (D. S. Bullock), in The American Museum of Natural History.

Helina adelpha (Schiner)

Spilogaster adelpha SCHINER, 1868, Dipt. Nov. Resa., p. 300.—STEIN, 1904, Ann. Mus. Nat. Hung., II, p. 432; 1907, Zeit. Hymen. Dipt., p. 209.

MALE.—5.5 mm. long. Head black, grayish pruinose. Front at narrowest point twice as wide as distance across posterior ocelli, inclusive, and one-fifth of head width. Frontal vitta at narrowest slightly wider than distance across ocelli and parafrontals at same level twice as wide as diameter of anterior ocellus. With only two or three bristles on anterior third of parafrontals. Juncture of parafacials and parafrontals about as long as width of third antennal segment, parafacials narrowed to one-third of antennal width below. Cheeks slightly higher than width of third antennal segment. Eyes bare. Antennae and palpi black. Third antennal segment two and three-fourths times as long as second. Longest hairs on arista not longer than its basal diameter.

Thorax black, grayish pruinose, indistinctly brown quadrivittate and with a narrow whitish vitta just laterad the dorsocentral series of bristles. Only three or four pairs of moderately well-developed presutural acrostical setulae and a prescutellar pair of acrostical bristles; dorsocentrals 2:3, with a weak postsutural pair of moderate setulae between first and second, and second and third pairs of bristles so that the dorsocentrals may appear to be 2:4 or 2:5; pra not more than one-third as long as posterior notopleural. Scutellar setulae sparse, confined to middle of disc of scutellum. Sternopleurals 2:2, the lower anterior one very weak and almost hair-like. Hypopleura and sternites bare.

Legs mostly black, the tibiae distinctly yellow and the basal portions of mid and hind femora yellow, but with blackish-gray pruinescence. The bases of tibiae slightly infuscated. Fore femora normal.

Fore tibiae with a strong median posterior and a much weaker and shorter median anterodorsal bristle. Mid femora with about seven long, slender ventral bristles on basal half and with the clothing setulae along anteroventral surface slightly longer and more distinct than usual, with a row of short anterior bristles on basal half and a distinct apical anterior bristle. Mid tibiae with two median posterior bristles. Hind femora with five or six short but distinct anteroventral bristles on apical half and a few shorter, more widely placed basal anteroventral setulae. Hind tibiae with one median anterodorsal and two to three shorter median anteroventral bristles.

Wings faintly brownish hyaline, the cross-veins very broadly infuscated with a few slender but distinctly developed costal setulae, the thorns distinct. All veins bare. Third and fourth veins subparallel at apices. Calyptrae pale, halteres orange.

Abdomen black, brownish gray pruinulent, with a pair of very large, black, sub-square spots on second and third visible tergites. Basal sternite bare; others with very short, sparse clothing setulae and a pair of slender, subapical bristles; fifth moderately cleft. Hypopygium black.

FEMALE.—6 mm. long. Similar to the male, differing from it in having the front at vertex one-third of head width, widened anteriorly. With a complete row of parafacial bristles, the posterior two inwardly, the others inwardly directed. With a distinct spot at juncture of parafacials and parafrontals which reaches from eyes to apex of second antennal segment.

SPECIMENS EXAMINED.—1 male and 1 female, Bogota (Colombia), January 4, 1937, H. Osorne coll. (Amer. Mus. Nat. Hist.), bears the label "Ex nest of *Bombus aratus*?"

According to Stein, specimens in the Bigot collection labeled as *adelpha* Schiner, by Bigot, are not the true *adelpha* but are another species similar to *duplicata* (Meigen).

Helina decora, new species

MALE.—5.5 to 6 mm. long. Head black, grayish brown pruinulent. Front at narrowest point about one and a fourth times as wide as diameter of anterior ocellus or half as wide as

width of third antennal segment. Parafrontals subcontiguous, the frontal vitta very narrow but distinct at middle. Three to five parafacial bristles and setulae which extend to narrowest portion of front. Juncture of parafacials and parafrontals almost as long as greatest width of third antennal segment, parafacials narrowed to one-third the antennal width below. Cheeks one and three-tenths times as high as width of third antennal segment, with three to four upwardly directed setulae at middle of ventral margin. Eyes bare, the facets above in front slightly larger than others. Antennae and palpi black, second segment very slightly orange at apex on inner surface. Third antennal segment one and six-tenths times as long as second. Longest arisal hairs as long as greatest width of third antennal segment.

Thorax black, grayish brown pruinulent, distinctly quadrivittate and with a central subshiny brown spot on scutellum. Presutural acrostical setulae in four rather regular rows, the outer rows slightly more well developed and a pair of prescutellar acrostical bristles; dorso-centrals 2:3; intra-alars 2; pra less than one-third as long as posterior notopleural bristle. Scutellar setulae not descending below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs black, trochanters brownish, the tibiae and a very narrow apical portion of femora yellowish. Fore femora normal. Fore tibiae with a median posterior bristle and a scarcely discernible median anterodorsal setula which is only slightly longer than the clothing setulae. Mid femora with four or five ventral, a row of shorter anterior bristles on basal half and an apical anterodorsal bristle. Mid tibiae with two strong and occasionally a weaker third posterior bristle. Hind femora with four or five anteroventral bristles on apical half, those at base of this group are about as long as diameter of femora where situated and become gradually longer and with a few fine setulose bristles on basal third which are about three-fourths as long as femoral diameter, no posteroventral bristles or setulae. Hind tibiae with one median anterodorsal bristle and with five or six median anteroventral and posteroventral weaker and shorter bristles.

Wings very faintly brownish hyaline. The anterior cross-vein broadly infuscated and with a narrower cloud along posterior cross-vein which is most distinct at its juncture with fourth and fifth veins. Costal setulae not, the thorns slightly developed. All veins bare. Third and fourth veins subparallel at apices. Posterior cross-vein almost straight. Calyptrae and halteres slightly brownish yellow.

Abdomen black with dense light brown pruinulences, a pair of distinct round, dark brown spots on second and third visible tergites and a very faint brownish dorsocentral vitta on second to fourth tergites. Basal sternite with a few hairs; others with a pair of distinct apical bristles; fifth moderately cleft, with a moder-

ately long bristle at base of each process. Hypopygium black.

TYPES.—Holotype, male, Huipulco (Mexico), August 21, 1922, E. G. Smyth coll. (U. S. Nat. Mus.); paratype, male, San José (Costa Rica), March, 1915 (Amer. Mus. Nat. Hist.).

There is a female without abdomen in the U. S. Nat. Mus. from Huipulco, bearing the same data as holotype, which is probably this species, although it is impossible to separate it from the female cotype of *signatipennis* v. d. Wulp, in the Ill. Nat. Hist. Surv. collection.

It differs from the male in having a distinct, shiny, brown spot extending from the eyes to apex of second and base of third antennal segments at juncture of parafacials and parafrontals. Front at vertex one-third of head width, widened to three-sevenths anteriorly, with a row of five or six pairs of parafrontal bristles, the posterior two outwardly, others inwardly directed and with numerous fine setulae laterad them.

Legs with the basal five-sixths of fore femora, three-fourths of mid femora and half of hind femora infuscated, rest of femora, tibiae and trochanters fulvous. Mid femora with three ventral bristles. Hind femora with three apical and basal anteroventral bristles. Hind tibiae with only three anteroventral bristles.

The male of the species is very similar to *signatipennis* v. d. Wulp but may be distinguished from it by the absence of the long basal anteroventral and row of posteroventral hair-like setulae and by the presence of posteroventral setulae on hind tibiae.

Helina poeciloptera (Schiner)

Spilogaster poeciloptera SCHINER, 1868, Dipt. Nov. Resa., p. 300.—STEIN, 1904, Ann. Mus. Nat. Hung., II, p. 440.

MALE.—6.5 to 7 mm. long. Head black, silvery gray pruinose. Front at narrowest point twice as wide as diameter of anterior ocellus. Parafrontals contiguous, each one as wide as diameter of anterior ocellus. With three strong parafrontal bristles and a few setulae which reach posteriorly three-fourths the distance to

contiguous portion of parafrontals. Junction of parafacials and parafrontals not quite as long as width of third antennal segment, parafacials almost obliterated below. Cheeks one and a fourth times as high as width of third antennal segment. Eyes bare. Antennae and palpi black, third antennal segment two and a half times as long as second. Longest arisal hairs almost as long as greatest width of third antennal segment.

Thorax black, yellowish gray pruinose, with four distinct brown vittae and a darkened spot in the center of the scutellum at its base. Presutural acrostical setulae in four to six irregular rows, with a pair of weak prescutellar acrostical bristles; dorsocentrals 2:3; intra-alars 2; pra short, about one-third as long as posterior notopleural bristle. Scutellar setulae sparse, reaching to level of marginals. Sternopleurals 1:2, occasionally with a very much weaker lower anterior setula; hypopleura and sternites bare.

Tarsi and coxae black, fore femora and basal half to three-fourths of mid and hind femora infuscated, rest of legs yellow. Fore femora normal. Fore tibiae with one or two very short anterodorsal setulae on apical half and a strong median posterior bristle. Mid femora with a row of five or six slender ventral bristles on basal half, and a few much shorter ones on basal third of anteroventral surface, a row of shorter anterior bristles on basal half and a distinct apical anterior to anterodorsal bristle. Mid tibiae with two median posterior bristles. Hind femora with five or six widely separated, long anteroventral bristles along with a row of short, hair-like setulae along entire anteroventral surface and a row of fine posteroventral hair-like bristles. Hind tibiae with one median anterodorsal and one or two anteroventral bristles on apical half to third which are longest toward apex.

Wings hyaline, with a large brown cloud over both cross-veins and another extending from posterior margin of node narrowly invading the discal cell and with a very faint costal cloud. Costal setulae not developed, the thorns small but distinct. All veins bare. Third and fourth veins slightly

divergent at apices. Calyptres white to pale yellow, halteres light orange.

Abdomen slender, slightly pointed, black, with dense yellowish to brownish-gray pruinescence. With a pair of distinct spots on second and third visible tergites, the larger bristles inserted into small, round spots. Basal sternites bare; others with a pair of long, fine discal and apical bristles and sometimes a shorter, weaker basal pair. Hypopygium black.

FEMALE.—6.5 to 7 mm. long. Similar to the male, differing from it in having the front at vertex one-fourth of head width, widened anteriorly, with three inwardly and two outwardly directed parafrontal bristles and numerous setulae opposite the former. Hind femora with six to eight anteroventral bristles but no finer, hair-like ones and only one or two fine hairs on basal fourth of posteroventral surface. Wings with costal cloud slightly more distinct and the cloud in the discal cell less distinct. Abdomen not yellowish but slate-gray, with the paired spots; only a few bristles inserted into spots. The sternal bristle not as well developed.

SPECIMENS EXAMINED.—1 male and 1 female, Camandcaia Mts., Minas (Brazil), 1600 meters, June 8, 1933, H. S. Lopes coll. (F. M. Snyder); 1 female, Nova Teutonia (Brazil), 27° 11' S., 52° 23' L., April 11, 1937 (F. M. Snyder).

The female from Minas returned to Señor Lopes.

Helina signatipennis (v. d. Wulp)

Spilogaster signatipennis VAN DER WULP, 1890, Biol. Cent. Amer., II, p. 322.—MALLOCH, 1921, Ent. News, XXXII, p. 43.

Very similar to *poeciloptera* Schiner, differing from it in having the parafacials as wide as juncture of parafacials and parafrontals which is as long as width of third antennal segment. Longest arisal hairs as long as narrowest width of third antennal segment.

All femora entirely black.

Wings with only the cross-veins infuscated.

Abdomen without the spots at base of the large abdominal bristles and setulae. Sternites with much shorter clothing setulae.

FEMALE.—Impossible to distinguish from the female described under *decora*, new species.

SPECIMENS EXAMINED.—1 male and 1 female, Guerrero, Mexico, cotypes, 9500 ft. (Ill. Nat. Hist. Surv. coll.).

Helina longipila (Stein)

Mydaea longipila STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 217.

MALE.—6.5 to 8 mm. long. Head black, brownish gray pruinescent, occiput grayish pruinescent. Front at narrowest point as wide as distance across posterior ocelli, inclusive. Frontal vitta of uniform width from middle of front to ocellar triangle. Each parafrontal about half as wide as the diameter of the anterior ocellus, with four or five pairs of strong bristles and several more weaker setulae which extend half way to the anterior ocellus. Juncture of parafacials and parafrontals about twice as long as width of third antennal segment, parafacials distinctly narrowed to half this width below. Eyes distinctly hairy. Cheeks twice as high as width of third antennal segment, with several rows of setulae along the lower margins, the most dorsal row of which is upwardly directed. Antennae and palpi black. Third antennal segment one and eight-tenths times as long as second. Longest hairs on arista about twice as long as its greatest diameter and about half as long as width of third antennal segment.

Thorax black, with slightly bluish-gray pruinescence and quadrivittate. With a distinct pair of presutural acrostical bristles, sometimes a pair of shorter and weaker ones in front of these and with a distinct pair of prescutellar acrostical bristles; dorsocentrals 2:4; intra-alars 2; pra quite short and weak, about half as long as posterior notopleural bristle. Scutellar setulae not descending below level of marginals. Sternopleurals 2:2, occasionally with an accessory additional pair in either the anterior or posterior group; hypopleura always and sternites usually bare.

Legs black, hind tibiae slightly yellowish to orange on apical two-thirds. Fore femora normal. Fore tibiae with a median

posterior bristle. Mid femora with a complete row of ventral bristles which are longest and strongest at base, the basal and apical anterior bristles very weak or absent. Mid tibiae with three or four median posterior bristles. Hind femora with a complete row of long, slender anteroventral, ventral and posteroventral bristles, the former longest at apex and the latter longest at base, the ventral series much shorter. Hind tibiae with two anterodorsal and one to three median anteroventral bristles, the posteroventral surface with a group of long, hair-like setulae on almost the entire surface, which are longest and more slender on the basal half and become shorter and stouter and more regularly placed on the apical half.

Wings slightly darkened at base, becoming lighter toward apex. Anterior cross-vein slightly infuscated. Costal setulae and thorns undeveloped. All veins bare. Third and fourth veins slightly divergent at apices. Calyptae white, halteres darkened, the knobs dark brown to black.

Abdomen black, grayish pruinose, when viewed in certain lights with a somewhat bluish tinge. Second and third visible tergites with a distinct pair of subtriangular large black spots. Basal sternite bare; others with numerous pairs of long, hair-like bristles; fifth moderately cleft. Hypopygium slightly brownish.

SPECIMENS EXAMINED.—4 males, Huariaca (Peru), 10,750 ft., December 20, 1913, C. H. T. Townsend coll. (U. S. Nat. Mus.).

In one or two specimens the prosternum has one or two long, fine, pale hairs on the posterior half which are scarcely discernible unless viewed in a very favorable light and angle. I do not believe that this character is constant enough to be used as a diagnostic character.

Longipila was originally described from material in the Bezzi collection from Olachea, Peru. The present specimens agree quite well with Stein's description, and I have little hesitancy in identifying them as this species, although I have not seen either type or authentically determined specimens.

Stein's description states that the pra is

entirely lacking, but in all the specimens before me the pra, while very short and weak, is nevertheless quite distinct. The legs, as stated in Stein's description, are black, while the specimens before me have the hind tibiae slightly orange colored. I do not believe these characters to be of enough importance to warrant proposing a new species for these specimens, since the very characteristic front, short plumose arista, leg bristling and wing, calyptae and halter coloring are the same.

See also remarks under *equator* and *browni*, new species.

Helina browni, new species

MALE.—8.5 mm. long. Similar to *longipila* Stein. Head colored as in that species. Front at narrowest point one and a fourth times as wide as the distance across posterior ocelli, inclusive. Each parafacial at the same level about half as wide as diameter of anterior ocellus, with a row of three or four long bristles on anterior half along with about five or six shorter ones and a row of shorter bristle-like setulae on posterior half so that the row reaches all the way to the anterior ocellus. Juncture of parafacials and parafrontals one and a third times as long as the greatest width of third antennal segment, parafacials narrowed to width of antennae below. Cheeks twice as high as width of third antennal segment, the vibrissal angle with numerous moderately stout upwardly directed setulae which are not continued on to the lower margin of cheeks as in *longipila*. Otherwise as in that species.

Thorax black, colored and marked as in *longipila* but with a slightly more bluish cast, with a single pair of well-developed presutural acrostical bristles. Otherwise bristles as in *longipila*.

Legs entirely black. Fore and mid legs bristled as in *longipila*. Hind femora with six apical anteroventral bristles, the posteroventral surface and basal half of anteroventral and ventral surfaces bare. Hind tibiae with two median anterodorsal and four anteroventral bristles and with a row of five or six shorter posterior bristles on median half.

Wings brownish hyaline, the base and the costal region distinctly opaque black. Wings otherwise as in *longipila*. Upper calyptae hyaline, distinctly margined with black, lower calyptae white, without darkened margins. Knobs of halteres black, the stalk somewhat lighter colored.

Abdomen as in *longipila* except that the hypopygium is entirely brownish black and somewhat shiny.

HOLOTYPE.—Male, Uyambicho, November 18, 1938, 2700 m., Ecuador.

Acc. No. 36,379, F. M. Brown coll. (Amer. Mus. Nat. Hist.).

Helina equator, new species

MALE.—7.5 mm. long. Head black, grayish pruinose, parafacials and parafrontals silvery. Front at narrowest point as wide as distance across posterior ocelli, inclusive. At the same level, each parafrontal about three-fourths and the frontal vitta twice as wide as diameter of anterior ocellus. With four to six pairs of strong parafrontal bristles and numerous shorter setulae, the latter reaching to the narrowest portion of front. Junction of parafacials and parafrontals twice as long as greatest width of third antennal segment, parafacials narrowed to one and a half times the antennal width below. Cheeks three times as high as width of third antennal segment, with several rows of numerous, closely placed, long, strong setulae along lower margin. Eyes with moderately dense, long hairs. Antennae and palpi black, the former inserted opposite middle of eyes. Third antennal segment one and three-fourths times as long as second. Longest arisal hairs half as long as greatest width of third antennal segment or about two and a half times as long as greatest arisal diameter.

Thorax slightly bluish black, with bluish-gray pruinescence, distinctly quadrivittate. With two pairs of strong presutural and one pair of prescutellar acrostical bristles; dorsocentrals 2:4; intra-alars 2; pra one-third as long as posterior notopleural bristle. Scutellar setulae reaching to or with one or two descending very slightly below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs black. Fore femora normal. Fore tibia with a median posterior bristle. Mid femora with an almost complete row of ventral bristles which are longest on basal half, a row of short, rather indistinct anterior bristles on basal half and with no bristles at apex of anterior surface. Mid tibiae with two median posterior bristles. Hind femora with seven or eight long anteroventral bristles on apical half, a row of more numerous, finer, bristle-like setulae on basal half which are half to three-fourths as long as diameter of femora where situated and eight to ten, long slender posteroventral bristles on basal four-fifths which are two to three times as long as femoral diameter. Hind tibiae with two median anterodorsal and anteroventral bristles and several median posterior bristle-like setulae.

Wings infuscated at base along costal region, becoming gradually smoky to light brownish hyaline at apex and along anal region. Cross-veins no more infuscated than longitudinal veins. Costal thorns and setulae scarcely developed. All veins bare. Third and fourth veins subparallel at apices. Penultimate section of fourth vein five-eighths as long as ultimate. Posterior cross-vein moderately curved at middle. Calyp-

trae white, the stalk of halteres brownish orange, the knobs yellow.

Abdomen black, with dense grayish-blue pruinescence, a pair of large, rather indistinct, black spots on second and a pair of smaller ones on third visible tergites. Basal sternite bare; others with moderately long clothing setulae and a pair of more well-developed apical bristles; fifth moderately cleft. Hypopygium black.

FEMALE.—8.5 to 9 mm. long. Similar to the male, differing from it in having head pruinescence distinctly brownish, a complete row of parafrontal bristles, the posterior two outwardly directed and with numerous setulae laterad all bristles. Front at vertex one-third of head width, widened to four-ninths anteriorly. Junction of parafacials and parafrontals one and three-fourths times as long as width of third antennal segment, parafacials narrowed to three-fourths the width of third antennal segment.

Thorax not as bluish, more brownish black, the pruinescence brownish.

Hind femora with the bristles arranged the same but not as long, the longest posteroventral ones not longer than one and a fourth times the femoral diameter. Hind tibiae without posterior bristle-like setulae.

Abdomen not as distinctly bluish pruinose, without spots but with dorsal and lateral checkerings. Sternites without as dense clothing setulae.

TYPES.—Holotype, male, Pichincha Prov. (Ecuador), 3000 m., November 5, 1938, F. M. Brown coll. Acc. No. 36,379 (Amer. Mus. Nat. Hist.); allotype, female, Miazza Ridge, Vol. Tungurahua (Ecuador), 3200 m., April 8, 1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.).

Helina anubes, new species

FEMALE.—7 mm. long. Head black, with slightly brownish-gray pruinescence and a slightly darker subshiny spot at junction of parafacials and parafrontals, front, including parafrontals, distinctly brownish. Front at vertex slightly less than one-third of head width, widened to not quite half anteriorly. With a complete row of parafrontal bristles, the anterior five inwardly, the posterior two outwardly directed, with numerous setulae laterad all of them, the anterior ones much more well developed. Junction of parafacials and parafrontals one and three-fourths times as long as width of third antennal segment, parafacials narrowed to three-fourths the width of third antennal segment below. Cheeks two and a half times as high as width of third antennal segment, with two or three rows of short, upwardly directed setulae along lower margin. Eyes with sparse but distinct hairs. Antennae and palpi black. Third antennal segment about one and three-fourths times as

long as second. Longest arisal hairs about one and a half times as long as greatest arisal diameter.

Thorax black, with rather dense, very slightly bluish-gray pruinescence, quadrivittate. With one weak and one strong pair of presutural acrostical bristles and a prescutellar acrostical pair; dorsocentrals 2:4; intra-alars 2; pra about half as long as the posterior notopleural bristle. Scutellar setulae not descending below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs black, hind tibiae reddish yellow at middle. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with four or five strong ventral bristles on basal half which form an almost continuous row with the shorter but distinct posteroventral bristle on apical half, a row of shorter, more numerous anterior bristles on basal half and no apical anterior bristles. Mid tibiae with two median posterior bristles. Hind femora with a complete row of anteroventral bristles, those on basal three-fourths not longer than greatest femoral diameter and with a row of finer posteroventral ones on basal half. Hind tibiae with two median anterodorsal and anteroventral bristles.

Wings very faintly brownish hyaline at extreme base. Cross-veins not infuscated. Costal setulae scarcely developed. All veins bare. Third and fourth veins slightly divergent at apices. Penultimate section of fourth vein as long as ultimate. Posterior cross-vein distinctly curved. Calyptrae white, with very pale, yellowish margins. Stalk of halteres brownish orange, the knobs pale orange.

Abdomen black, rather densely, slightly bluish gray pruinescent, with dorsal and lateral checkerings. Basal sternite bare; others with a pair of apical bristles and moderately short clothing setulae. Cerci brownish, rather short but quite broadened.

HOLOTYPE.—Female, Urbina Cerro, Chimborazo (Ecuador), 3650 m., April 18, 1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.).

Helina brevivena, new species

FEMALE.—7 mm. long. Head black, parafacials, cheeks and front grayish and parafrontals slightly yellowish gray pruinescent, the former including frontal vitta with moderately dense bluish silvery-white pruinescence. Front at vertex five-fourteenths of head width, widened to six-fourteenths anteriorly. With three or four inwardly and two outwardly directed, strong parafrontal bristles and numerous setulae laterad all of them. Juncture of parafacials and parafrontals twice as long as width of third antennal segment, parafacials narrowed to one and three-fourths times this width below. Cheeks two and a half times as high as width of third antennal segment or three-

eighths of eye height. Eyes with very sparse, long hairs. Antennae and palpi black. Third antennal segment one and eight-tenths times as long as second. Longest hairs on arista not as long as its basal diameter.

Thorax black, densely golden yellow pruinescent, with four brownish vittae. With a pair of presutural acrostical bristles and without prescutellar acrostical bristles; dorsocentrals 2:3 or 2:4; intra-alars 2; pra one-third as long as posterior notopleural bristle. Scutellar setulae sparse on disc but with more numerous ones descending below level of marginals. Sternopleurals 2:2. Hypopleura and sternites bare.

Legs black, the apical fourth to fifth of femora and tibiae entirely reddish orange. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with an almost complete row of slender ventral bristles, those on basal half twice as long as femoral diameter, a complete row of long anteroventral setulae, a row of anterior setulae on basal half and a distinct apical anterodorsal bristle. Mid tibiae with two anterodorsal and three to five median posterior bristles. Hind femora with three or four long anteroventral bristles on apical half, a row of very short anteroventral setulae and a few short posteroventral setulae on basal half. Hind tibiae with three anterodorsal and three or four anteroventral median bristles.

Wings yellow hyaline, especially at base. The strongly curved posterior cross-vein infuscated. Costal setulae and thorns rather long. All veins bare. Third and fourth veins subparallel at apices. Penultimate section of fourth vein as long as or longer than the ultimate. Calyptrae and halteres pale orange.

Abdomen black with slightly yellowish-gray pruinescence and distinct dorsal and lateral checkerings. Basal sternite hairy; others without distinct apical bristles, the clothing setulae moderately short but dense.

TYPES.—Holotype, female, Cumbre Tiliac Chimborazo (Ecuador), 4200 m., April 21, 1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.); paratype, female, same data as holotype.

The holotype has three postsutural dorsocentral bristles and three median posterior bristles on mid tibiae, while the paratype has four dorsocentrals and five posterior bristles on mid tibiae. Since the paratype was apparently injured in emerging from the puparium, because of the crumpled left wing and hind femora, I believe the dorsocentral and mid tibiae number may not be normal and therefore do not treat this specimen as a distinct species, since the coloring and other characters are the same in the two specimens.

Helina notha, new species

FEMALE.—8.5 to 9 mm. long. Head black, the parafacials, parafrontals, cheeks and frontal vitta seal-brown pruinulent, occiput grayish pruinulent. When viewed from above and behind with a shiny brown spot which extends from eyes to base of antennae at juncture of parafacials and parafrontals. Front at vertex not quite three-tenths of head width, distinctly widened anteriorly. With a row of four strong and one weak inwardly and two strong outwardly directed parafrontal bristles, with some short setulae laterad all of them. Juncture of parafacials and parafrontals one and a half times as long as greatest width of third antennal segment, parafacials narrowed to about antennal width below. Cheeks two and a fourth times as high as width of third antennal segment, with several rows of setulae along lower margin in front and with a single row of much shorter ones behind. Eyes with rather long, moderately dense hairs. Antennae and palpi black. Third antennal segment one and two-thirds times as long as second. Longest hairs on arista about one and a half times as long as its greatest diameter.

Thorax brownish black, rather densely grayish brown pruinulent, distinctly quadrivittate. With a pair of presutural acrostical bristles and a pair of prescutellar acrostical bristles which are situated on a level between third and fourth postsutural dorsocentral bristles; dorsocentrals 2:4; intra-alars 2; pra about three-fourths as long as posterior notopleural bristle. Scutellar setulae descending below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs black. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with a complete row of ventral bristles and a row of shorter but more numerous anterior bristles on basal half, no apical bristles on anterior surfaces and the anteroventral setulae on apical half longer and stronger than usual. Mid tibiae with four median posterior bristles. Hind femora with a complete row of anteroventral bristles, a row of longer and more slender posteroventral bristles on basal half and a row of shorter ones on apical half. Hind tibiae with two or three median anterodorsal and anteroventral bristles.

Wings extensively infuscated at base. Cross-veins no more infuscated than longitudinal veins. Costal setulae and thorns scarcely developed. All veins bare. Fourth vein very slightly curved forward apically, the apex parallel with third. Penultimate section of fourth vein a little over half as long as ultimate. Halteres and margins of upper and lower calyptrae black.

Abdomen distinctly blackish blue, with sparse grayish pruinulence, unmarked. Basal sternite bare; others with a pair of moderately long apical bristles and clothing hairs.

HOLOTYPE.—Female, Miazza Ridge, Vol. Tungurahua (Ecuador), 3200 m., April 8,

1939, F. M. Brown coll. (Amer. Mus. Nat. Hist.).

Helina inepta (Stein)

Mydaea inepta STEIN, 1911, Archiv f. Natur., (A-1), LXXVII, p. 82.

FEMALE.—7 mm. long. Superficially resembles *acrosticalis*, new species. Head black, yellowish gray pruinulent. Front at vertex one-third of head width, distinctly widened anteriorly. With a complete row of setulae adjacent parafrontal bristles, all of which are inwardly directed except the posterior pair which are outwardly directed. Juncture of parafacials and parafrontals as long as length of the short third antennal segment, about one and a half times as wide as its greatest width, parafacials narrowed to its width below. Cheeks almost one-third of eye height, with two or three rows of upwardly directed setulae on anterior half of the lower margin. Eyes short-haired. Palpi brownish, infuscated on apical half to three-fourths. Antennae black, third segment one and a fourth to one and a third times as long as second. Longest hairs on arista about as long as its greatest diameter.

Thorax black, with brownish to yellowish-gray pruinulence, four distinct brown vittae and an indistinct brown prescutellar dorsocentral vitta. With a strong pair of presutural acrostical bristles, the presutural and postsutural acrostical setulae very sparse and short, but with a pair of prescutellar acrostical bristles; dorsocentrals 2:4; intra-alars 2; pra two-thirds as long as posterior notopleural bristle. Scutellar setulae more numerous than in *acrosticalis*, but not descending below level of marginals. Sternopleurals 2:2; hypopleura and sternites bare.

Legs mostly yellow, the femora usually with an indistinct infuscated dorsal stripe which is distinctly whitish gray pruinulent; coxae and tarsi black and fore femora with a distinct posterodorsal infuscated stripe. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with four ventral and a row of distinct anterior bristles on basal half, no apical anterior bristles. Mid tibiae with two median posterior bristles. Hind

femora with a row of short anteroventral bristles, only the subapical one as long as diameter of femora where situated and with two to four posteroventral setulae on basal third. Hind tibiae with one strong anterodorsal and two to three weaker anteroventral median bristles.

Wings slightly yellowish hyaline. Cross-veins very broadly infuscated, the cloud at posterior cross-vein broadest at its juncture with fourth vein. Posterior cross-vein strongly curved at middle. Costal setulae and thorns undeveloped. All veins bare. Fourth vein distinctly deflected posteriorly at apex. Calyptres white, the margins pale yellow; halteres yellow.

Abdomen black, grayish pruinose, with distinct dorsal and lateral checkerings. Basal sternite bare.

SPECIMEN EXAMINED.—1 female, Peru, 1914, H. H. Parish coll. (U. S. Nat. Mus.).

The strongly backwardly curved fourth vein, the broadly infuscated cross-vein should at once distinguish this species from any other occurring in South America. *Acrosticalis*, new species, is somewhat similar, having the distinct presutural acrostical bristles, but the fourth wing-vein is only slightly backwardly curved and the posterior cross-vein is only slightly infuscated.

Helina discolor (Stein)

Mydaea discolor STEIN, 1911, Archiv f. Nat., (A-1), LXXVII, p. 83.—MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 305.

Originally described from Peru by Stein and subsequently recorded from Bariloche, Chile, by Malloch. I have not seen this species.

Helina viola Malloch

MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 303.

It is with some hesitation that I include this species without having seen it because of the unusual color and structural characters.

Helina chilensis Malloch

MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 312.

Upon measuring the length of the arisal hairs on the holotype, in the U. S. National

Museum, I find that they are four-fifths as long as width of third antennal segment. Most of the hairs appear to be broken off and probably account for Malloch's statement that they are about half as long as width of third antennal segment.

Helina simplex Malloch

MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 309.

I have seen only the holotype in the U. S. Nat. Mus.

Helina dubia (Bigot)

Yctodesia dubia BIGOT, 1885, Ann. Soc. Eng. France (6) IV, p. 294.—STEIN, 1901, Zeits. f. Hymen. Dipt., p. 274.—MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 304.

I have included this species upon the basis of the descriptions given in the above references.

Helina townsendi, new species

MALE.—7 mm. long. Parafrontals, parafrontals and cheeks black, with dense slightly brownish-gray pruinescence. Front at narrowest as wide as distance across posterior ocelli, inclusive. At narrowest frontal vitta twice as wide as diameter of anterior ocellus, and each parafrontal about three-fourths as wide as diameter of anterior ocellus. With four or five strong parafrontal bristles and numerous setulae which reach to but not beyond narrowest part of front. Junction of parafrontals and parafrontals one and a fourth times as long as width of third antennal segment, parafrontals narrowed to three-fourths its width below. Cheeks almost three times as high as width of third antennal segment and about one-third of eye height, with two or three rows of upwardly directed setulae along lower margin, those in front distinctly more well developed. Eyes distinctly haired. Antennae and palpi black. Third antennal segment twice as long as second. Longest hairs on arista slightly more than twice as long as its basal diameter and almost half as long as width of third antennal segment.

Thorax black, grayish pruinose, distinctly quadrivittate. Two pairs of distinct presutural acrostical bristles, the posterior pair almost as long and strong as the dorsocentral bristles, the anterior pair half as long and strong as the posterior pair, the acrostical setulae in four to six irregular rows and with a pair of weak presutellar acrostical bristles; dorsocentrals 2:4; intralars 2; pra short, not more than one-third as long as posterior notopleural bristle. Scutellar setulae not descending below level of marginals. Sternopleurals 2:2. Hypopleura and sternites bare.

Legs black, only the apical third of mid

femora, apical two-thirds of hind femora and hind tibiae orange-yellow. Fore femora normal. Fore tibiae with a median posterior bristle. Mid femora with a row of ventral bristles on basal half, no anterior row of setulae or bristles and only an apical anterodorsal setula. Mid tibiae with four posterior bristles. Hind femora with six to eight anteroventral bristles on apical half, those toward apex longest. Hind tibiae with three median anterodorsal and anteroventral bristles, and a series of six to nine short posterior bristles or setulae at middle.

Wings uniformly very slightly brownish black hyaline. Cross-veins not infuscated. Costal setulae and thorns undeveloped. All veins bare. Third and fourth veins divergent at apices. Posterior cross-veins very distinctly curved, joining the fourth vein at its middle beyond the anterior cross-vein. Calyptrae almost white, halteres orange.

Abdomen black, brownish gray pruinose, with very distinct dorsal and lateral checkerings, the larger bristles inserted in small dark spots, when viewed from behind with a pair of large, square dark spots on second and third visible tergites and a grayish dorsocentral vitta. Basal sternite bare; others with a pair of distinct apical bristles; fifth moderately cleft, the discs of processes with a row of short, only moderately distinct bristles. Hypopygium black.

HOLOTYPE.—Male, Huariaca (Peru), 10,750 ft., December 21, 1913, C. H. T. Townsend coll., determined as *Helina biseta* Stein, by Aldrich.

Biseta Stein¹ was originally described on the basis of a female from Callanga, Peru. I have not seen this species, but the description calls for three dorsocentral bristles and two anterodorsal and one ventral median mid tibiae bristle in addition to the usual four or five posterior bristles. The presence of anterodorsal bristles is often sexual, but in none of the related species, i.e., *chilensis* Malloch, *simplex* Malloch and *discolor* Stein, which possess either ventral or posteroventral bristles, is this character sexual.

¹ Stein, 1904, Ann. Mus. Nat. Hung., II, p. 44.

Helina fulvocalyptrata Malloch

MALLOCH, 1934, Dipt. Pat. So. Chile, pt. VII, fasc. 2, p. 311.

Besides the allotype female from Bariloche, Chile, in the U. S. National Museum, I have seen a male from Tierra del Fuego, February 2, 1938 (J. Bird), in The American Museum of Natural History. There is a female paratype in the U. S. National Museum which has entirely fulvous femora. It may be closely related to *dubia* (Bigot) but because of the lack of more material I do no more than mention it at this time.

Helina bigoti Malloch

MALLOCH, *op. cit.*, p. 312.

Included upon the basis of five male and three female paratypes from Ancud and Castro, Chile, in the U. S. Nat. Mus.

Helina connexa Malloch

MALLOCH, *op. cit.*, p. 309.

Two male and two female paratypes in U. S. National Museum from Casa Pangue, Puerto Blest and Correntosa, Chile.

Helina bifimbriata Malloch

MALLOCH, 1934, *op. cit.*, p. 307.

Thirteen male and ten female paratypes from Bariloche, Correntosa, Los Loros, Puerto Blest and Casa Pangue, Chile, in U. S. National Museum.

Helina bifimbriata var. *basalis* Malloch

MALLOCH, *op. cit.*, p. 308.

Nine male paratypes in U. S. National Museum from Puerto Blest, Casa Pangue, Los Loros and Bariloche, Chile.

Helina bifimbriata var. *grisea* Malloch

MALLOCH, *op. cit.*, p. 308.

I have not seen the single specimen known only from Puerto Blest, Chile.

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THE OSTEOLOGY AND RELATIONSHIPS OF *ARCHAEOMERYX*, AN ANCESTRAL RUMINANT¹

By EDWIN H. COLBERT

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INTRODUCTION

The genus *Archaeomeryx* was first described by Matthew and Granger in 1925, upon the basis of a large series of teeth, skulls and portions of skulls, skeletal elements, and several associated skeletons, all of which had been discovered in the Upper Eocene Shara Murun formation of Mongolia by the Asiatic Expeditions of The American Museum of Natural History. In their original description, these authors gave a detailed diagnosis of the type species, accompanied by figures of the dentition. They also made a few remarks in this publication regarding the importance of this new form, as follows:

"This genus is of exceptional interest, as it appears to be an approximate ancestral type for the pecora. It has assumed the characteristic pecoran-traguline character of the united naviculo-cuboid, but it still retains the separate median pair and complete lateral pair of digits, the ulnar

and fibular shafts are more primitive than in any pecora, the upper incisors are still retained, the premolars are of primitive pattern, the molars brachyselenodont. It lacks any of the various aberrant specializations which exclude all of the Eocene genera hitherto described from direct ancestry to the pecora and, as fortunately the principal osteological and dental characters are determinable from the exceptionally complete material, the affinities of the genus can be very satisfactorily appraised. So far as the higher ruminants are concerned, it affords tangible and very convincing proof of the theory of an Asiatic dispersal center."²

Beyond the original description of the genus, there has been very little notice taken of it in the literature, except for passing references in the course of general discussions dealing with ruminant evolution. Since, because of its relatively early age and its generally unspecialized habitus, this is

¹ Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution number 144.

² Matthew, W. D., and Granger, Walter, 1925. Amer. Mus. Novitates, No. 196, pp. 10-11.

one of the most important of the ruminants from an evolutionary standpoint, it has seemed advisable to make a detailed study of the genus as based upon the original materials, comparing it with other primitive ruminants in an effort to determine the actuality of its position as a possible struc-

tural ancestor for the pecorans. It is thought that such a detailed and comparative osteological description, together with additional figures, will give to palaeontologists and zoologists an increased appreciation and knowledge of this important form.

The illustrations were made by Mr. John C. Germann.

MATERIALS UPON WHICH THE PRESENT STUDY IS BASED

All of the specimens listed below were found in the upper Eocene Shara Murun formation, at Ula Usu, Mongolia. All belong to the type species, *Archaeomeryx optatus* Matthew and Granger, 1925.

Amer. Mus. No. 20311, type. Palate and mandible.

20312, palate and lower jaws.

20313, upper and lower jaws.

20314, upper and lower jaws.

20315, upper and lower jaws.

20316, portions of upper jaws; right M^2-M^3 , left P^4-M^3 .

20317, upper and lower jaws.

20318, upper and lower jaw fragments.

20320, articulated skeleton.

20321, skull and jaws, part of skeleton, lumbar, pelvis and part of hind limb.

20322, skull and jaws, pelvis and hind limbs with articulated feet, fore limbs and feet.

20323, miscellaneous upper and lower jaws and foot bones.

20324, miscellaneous upper and lower jaws and foot bones.

20325, miscellaneous upper and lower jaws.

Numerous teeth and skeletal elements, not numbered, representative of at least 38 individuals.

It may be seen that *Archaeomeryx optatus* is known from a considerable series of specimens, including literally dozens of dentitions. Thus it is possible to present a rather thorough study of the osteology of this animal and to attempt a reconstruction of the skeleton upon a solid foundation of factual evidence, with the one exception that in all cases the skulls are crushed, thereby making a restoration of the skull exceedingly difficult.

A REVIEW OF THE OSTEOLOGY OF *ARCHAEOMERYX OPTATUS*

ANALYSIS OF THE DIAGNOSTIC CHARACTERS OF *Archaeomeryx*

The description by Matthew and Granger, though brief, is remarkably complete, and there are but few important points in the anatomy of this genus to be added to what these authors have already so lucidly described. On the basis of the original description of the genus and the characters shown by the material at hand, a diagnosis of the generic type may be presented as follows.

Archaeomeryx optatus

1.—Of small size, approximately equal in this respect to the modern *Tragulus*.

2.—Skull hornless, with relatively small braincase, prominent occipital crest, and small orbit closed posteriorly. Mandible rather heavy.

3.—Dental formula $3/3, 1/1, 3/4, 3/3$.

4.—Upper incisors well developed; upper canine of medium size; short post-canine diastema; three upper premolars; upper molars brachyodont, quadritubercular, with strong parastyle and mesostyle and well-developed internal cingulum.

5.—Lower incisors procumbent; lower canine incisiform and in series with incisors; first lower premolar caniniform and set apart by short diastemata from canine in front and from second lower premolar behind; lower premolars compressed and trenchant, the last with a well-developed inner cusp and a posterior basin; lower molars quadritubercular.

6.—Back rather long, with heavy vertebrae. Sacral vertebrae showing little fusion. Tail very long.

7.—Radius and ulna separate. Carpals separate. Metacarpals separate, the lateral toes being complete but somewhat reduced.

8.—Pelvis not fused to sacrum. Fibula reduced, only the proximal and distal ends being

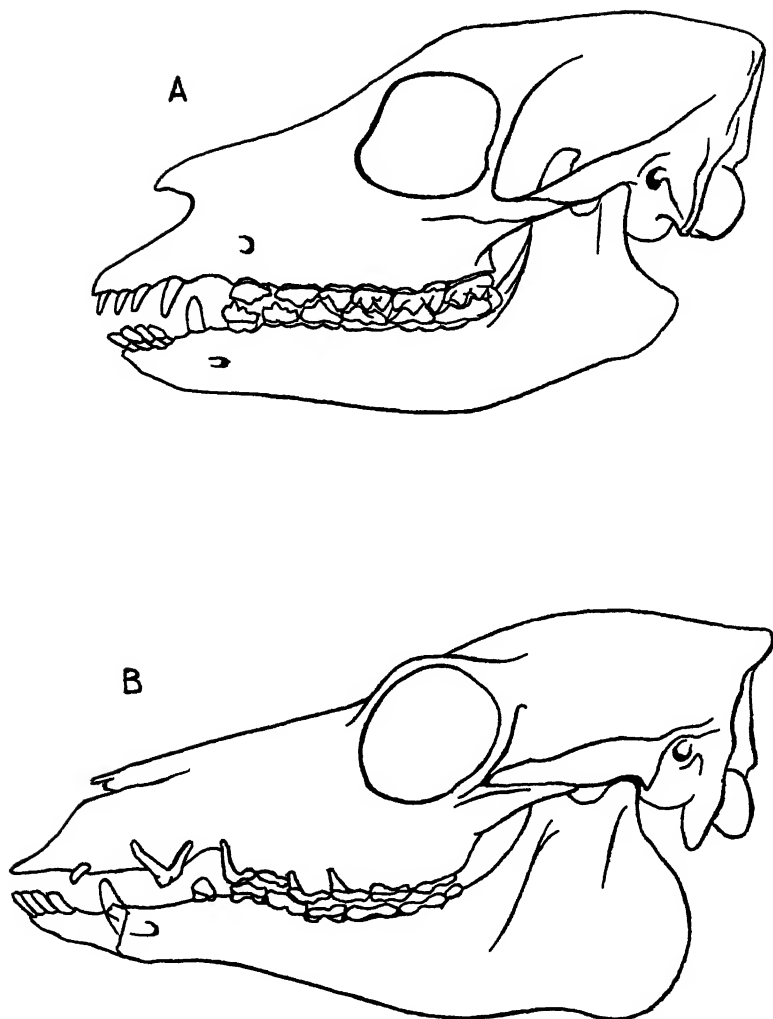


Fig. 1. Comparison of the restored skull and jaw of (A) *Archaeomeryx optatus* Matthew and Granger, based upon Amer. Mus. Ncs. 20311, 20320, 20321, 20322, with that of (B) *Hypertragulus hesperius* Hay, Amer. Mus. No. 7918, type. Drawing of *Hypertragulus* adapted from Frick, 1937. Lateral views, natural size.

retained. Astragalus completely artiodactylid. Cuboid and navicular fused. Metatarsals separate, the lateral toes being complete but somewhat reduced.

THE COMPARATIVE OSTEOLOGY OF *Archaeomeryx*

In this comparative review of the osteology of *Archaeomeryx*, the genus will be considered in the light of the resemblances

and differences shown as it is compared with certain important genera truly representative of related families and subfamilies of traguloids.¹ Thus, *Archaeomeryx* will be compared so far as is possible with the primitive Eocene genus *Amphimeryx*, representative of the family Amphimerycidae.

¹ The basis for the classificatory terms here used will be elucidated on a subsequent page of this work.

In comparing it with the hypertragulids, the comparison will be largely with *Hypertragulus* itself, since this form is perhaps as typical as any member of the family. None of the protoceratids will be brought into this comparative study, because they are so highly specialized as to be of little concern to us in this connection. On the other hand, comparisons with the true Tragulidae will be necessary—with *Gelocus* as typical of the subfamily Gelocinae, and particularly with *Tragu'us* itself, as a central type representative of the subfamily Tragulinae. In all of these comparisons, emphasis will be placed especially on the resemblances and differences between *Archaeomeryx*, *Hypertragulus* and *Tragulus*.

The Skull

It is an interesting fact that the skulls of *Archaeomeryx*, *Hypertragulus* and *Tragulus* are all of about the same size; naturally, the same statement will hold for the skeletons, too. And judging from maxillae, mandibles and dentitions, the same is true for *Amphimeryx* and *Gelocus*. All of which means, of course, that in these several genera, representative of as many different subfamilies, the primitive ruminant or pecoran heritage has been retained so far as size is concerned. Evolution of most mammals from early Tertiary ancestors usually—although not always—has entailed an increase in size, and the mere fact that there has been no important growth increments in the various traguloids named above is in itself one indication of the slight amount of structural evolution that has taken place within these ruminants.

Archaeomeryx, *Hypertragulus* and *Tragulus*, all have hornless skulls—again a primitive heritage character for the ruminants. Because of the crushing of the specimens, nothing definite can be determined as to the size of the braincase in *Archaeomeryx*, but there is good reason to believe that it was about equal to the braincase of *Hypertragulus*.

In this respect, *Hypertragulus* and *Tragulus* are very similar to each other, which may be some indication that the modern chevrotain has stayed at about the "Oligocene level of intelligence" among the primi-

tive ruminants. Continuing, the orbit in *Archaeomeryx* is seemingly smaller in proportion to the size of the skull than is the case in *Hypertragulus* or *Tragulus*, as might be expected when comparing an Upper Eocene genus with forms of a later date. An interesting character of *Archaeomeryx* is the apparent closing of the orbit posteriorly, showing that this advanced ruminant character probably was established at a very early date in the history of the suborder, even though in some later forms, such as *Hypertragulus*, the orbit tends to remain open posteriorly.

The horizontal ramus of the mandible in *Archaeomeryx*, though not so deep, is thicker and heavier than is the case with the rami of *Hypertragulus* and *Tragulus*.

These are the principal comparisons to be made in a consideration of the genera discussed above, further discussion being made impracticable because of the very crushed condition of the several known skulls of *Archaeomeryx*.

The Dentition

Archaeomeryx seemingly is unique among the pecorans in the possession of functional upper incisors. Matthew, in 1902, indicated by his text-figures a belief that the upper incisors might have been present in *Hypertragulus* and *Hypisodus*, while Frick, in 1937, indicated in some of his figures the possibility of a very small third incisor being retained in the premaxilla of the Hypertragulidae. Professor Scott, in his recent monograph of White River Artiodactyla (1940), mentions "minute alveoli" as being present in the premaxillae of *Hypertragulus*, and shows very clearly that there were very small, non-functional upper incisors present in the premaxillary alveoli of *Leptomeryx*. Since the complete premaxillae are not known in *Hypisodus*, the presence or absence of upper incisors, either functional or vestigial, is not known. It is quite evident, however, that in these Oligocene hypertragulids the upper incisors, when present are on the verge of being suppressed, so they cannot be considered as functional units in the dentition.

The upper canine is of medium size in *Archaeomeryx* as is the case in the more ad-

vanced *Hypertragulus*, but in both of these genera it is much smaller than in *Tragulus*. Therefore it seems logical to regard the large canines in the chevrotain as being due to a secondary enlargement, and not as basically primitive. The same probably is true of the primitive deer. The canine is

internal cusp, seemingly a primitive character since this structure is well developed in the Uinta genus, *Leptotragalus*, but is reduced in *Hypertragus* and *Tragulus*. The fourth premolar is of the usual ruminant form, with an outer cusp and an inner crescent.

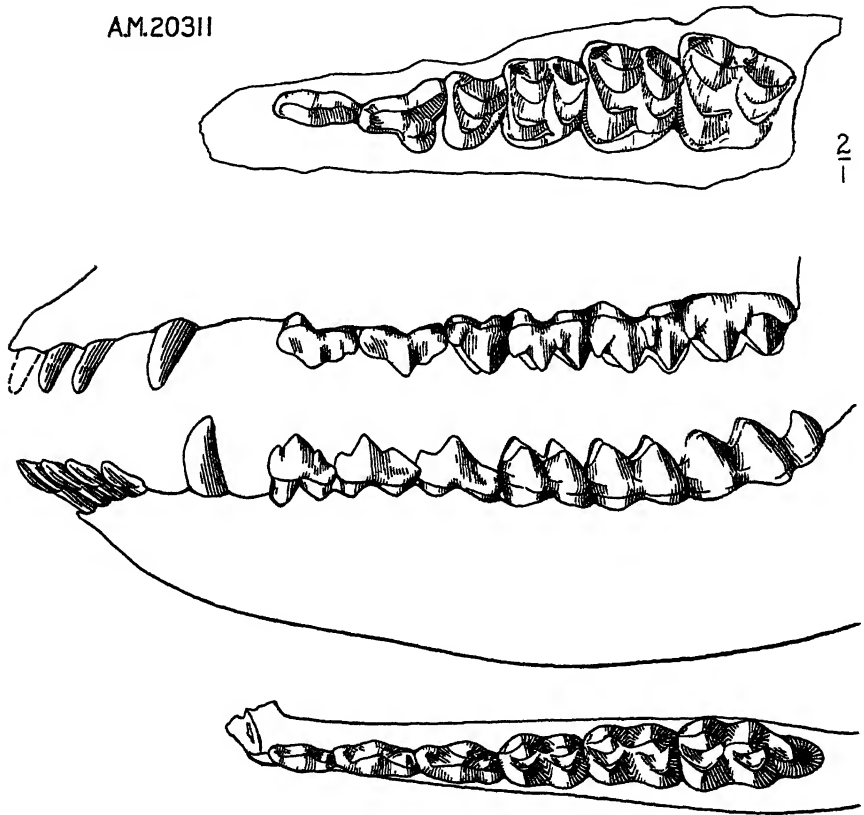


Fig. 2. *Archaeomeryx optatus* Matthew and Granger, Amer. Mus. No. 20311, type, upper and lower dentition. Revised from Matthew and Granger, 1925. Crown and external lateral views, twice natural size.

separated by a short diastema from the second premolar. Seemingly the first premolar had been lost in *Archaeomeryx*, in which respect, as in the case of the closed orbit, this genus is less primitive than the Oligocene *Hypertragulus*. The premolars on the whole closely resemble those of the New World hypertragulids. In the third member of the series there is a very large

The upper molars are quadricuspid as in the advanced ruminants, so that *Archaeomeryx* resembles *Hypertragulus* and *Tragulus*, and differs from *Amphimeryx* in which a protoconule is retained. It is unfortunate that our knowledge of *Amphimeryx* is not more complete, for the dentition suggests that this is probably a very primitive pecoran—probably more primitive than

Archaeomeryx if all the facts were known. On the other hand, the molars of *Archaeomeryx* are very brachyodont, as much as in any other ruminant, even *Amphimeryx*, and are distinguished by internal cingula and very heavy external styles—all of which suggest that in these respects, at least, *Archaeomeryx* is perhaps more primitive than *Amphimeryx*.

The lower incisors and the lower canine of *Archaeomeryx* show the usual ruminant character, being closely appressed and in series. These teeth are much more procumbent and more chisel-shaped than indicated in the type figure, resembling in this respect the same teeth in *Hypertragulus*. *Tragulus* is specialized beyond the condition just described in that the central incisor is much broadened, so that it is "shovel-shaped." The lower first premolar

Ratio, $\frac{\text{length of fourth cervical}^1}{\text{length of molar series}} \times 100$	
Ratio, $\frac{\text{length of tenth dorsal}}{\text{length of molar series}} \times 100$	
Ratio, $\frac{\text{length of fourth lumbar}}{\text{length of molar series}} \times 100$	

¹ Length of centrum.

of *Archaeomeryx* is caniniform, and separated from the canine in front of it and the second premolar behind it by short diastemata. The presence of this caniniform tooth, a hypertragulid feature, is in distinct contrast to *Tragulus*, in which the first lower premolar is completely suppressed. As in the upper jaw, the last three premolars are clearly hypertragulid, especially P_4 , in which there is a prominent cusp internal to the main cusp and a basined heel—structures duplicated in the P_4 of *Hypertragulus* but not to be seen in the more specialized, trechant tragulid premolars.

The lower molars are quadricuspid and brachyodont, as might be expected. The heel of the third molar, as in the hypertragulids, is more primitive than it is in the tragulids in that its long axis is parallel to the long axis of the tooth, so that its rim is less crescentic than is the talonid of the modern tragulids.

The Axial Skeleton

The vertebral formula of *Archaeomeryx* is: cervicals—7, dorsals—13, lumbar—6, sacral—2 or 4, caudals—numerous. The vertebral column is characterized by the large size of the individual elements composing it, the vertebrae, particularly the post-cervicals, being larger and heavier, and especially longer in comparison to the size of the animal, than is the case in the modern *Tragulus*, for instance. This means, of course, that *Archaeomeryx* had a relatively longer back than the recent tragulids, especially in the dorsal and lumbar regions, as might be expected in an earlier and a generally more primitive form. The difference is well illustrated by the ratio of the length of certain vertebrae to the molar series in *Archaeomeryx* and *Tragulus*.

Even though the fossil and the recent

<i>Archaeomeryx</i>	<i>Tragulus</i>
63	63
77	56
109	87

forms show a similarity of size in the cervical vertebrae, the extinct form is the more primitive in that the articular surfaces of the centra are more nearly vertical than in the modern genus, and likewise the neural arch and zypophyses are seemingly slightly less expanded.

In the sacrum of *Archaeomeryx* the vertebrae are separate, for the most part freely articulating elements, whereas in *Tragulus* these are firmly fused into one solid structure, the result of evolutionary development over a long period of time. It is interesting to see that in one sacrum of *Archaeomeryx* the second and third vertebrae are fused, although the other members of the series are free. The number of sacral vertebrae in *Archaeomeryx* is difficult to fix definitely, due in part at least to the varying definitions as to what constitutes a sacrum in the mammals. In most systematic works the Artiodactyla are said to

have four or five sacral vertebrae, a statement based upon the condition found in modern artiodactyls, in which there has been a considerable amount of fusion within the sacral region. If the sacrum be defined upon strictly morphological grounds, then the sacrum of a great majority of the mammals must be limited to the two anterior vertebrae that are actually connected with the ilia. In *Archaeomeryx* the first two sacral vertebrae show a direct connection with the ilia, and may thus be regarded as the true sacrals. It is quite evident that the two vertebrae following the second true sacral and occasionally fused might be regarded as sacrals, in which case they would be numbers three and four of the series. This condition may be compared with that of *Leptomeryx* in which there are five fused vertebrae, of which only the first two attach to the ilia, and with that of *Tragulus* in which a somewhat similar condition prevails. In the recent genus, the sacrum is complicated by the excessive secondary ossification that has taken place in the lumbar and pelvic regions, whereby there has been built a bony bridge from the tuber ischii to the posterior "sacrals," thereby firmly connecting the back of the sacrum with the ischii. This ossification has involved the inclusion of another vertebrae in the sacrum, so that there are in a way six "sacrals."

The greatest vertebral difference between *Archaeomeryx* and *Tragulus* is in the caudal region, for in *Archaeomeryx* the tail was quite long, while in the modern *Tragulus* it is very short. According to Scott, there was a short, slender tail in *Hypertragulus*. Naturally, the individual caudal vertebrae of the Eocene genus are elongated and rather heavy elements.

No remarks of consequence can be made as to the ribs and sternum in *Archaeomeryx*.

The Appendicular Skeleton

THE FORE-LIMB

The scapula in *Archaeomeryx* is not well preserved, but from the various fragments available, this element would seem to show no particularly distinctive features.

The humerus, so far as can be determined, is very similar to the same element

in *Hypertragulus* and in the recent *Tragulus*, both as to size and as to form.

The radius and ulna bear about the same proportional relationships, so far as length is concerned to the humerus as is the case with *Hypertragulus* and *Tragulus*. These two bones in *Archaeomeryx* are distinctive in not being coossified, thereby showing in this genus a more primitive stage of phylogenetic development than do most of the later and more advanced ruminants, including *Hypertragulus* and *Tragulus*. Also, the ulna shows a lesser degree of reduction of the shaft than does the same element in *Hypertragulus* and *Tragulus*, being in this respect similar to the ulna of *Leptomeryx*.

In the manus there are four digits, all separate. The lateral metacarpals are relatively heavy, in which respect they are rather closely comparable to the same elements of *Hypertragulus*. Indeed, so far as can be determined the entire manus of *Archaeomeryx* is rather closely comparable to the manus of *Hypertragulus*. It is not possible to determine for certain the number of toes in the manus, because of the crushed condition of the material, but it would seem that the pollux probably was suppressed, in which case the Mongolian genus would be more advanced than *Hypertragulus*, in which there are five digits in the fore-foot.

THE HIND-LIMB

The pelvis of *Archaeomeryx* is of the usual pecoran type; that is, it does not show the specializations seen in the pelvis of *Tragulus*, where in the males especially, there is a neomorphic structure in the form of a longitudinal bridge of bone on either side, connecting the fused sacral vertebrae with the dorsal portion of the ischium. In *Archaeomeryx* the pelvis is relatively strong and heavy, with flaring ilia, the inner surfaces of which articulate with the large first two sacral vertebrae. The pubes are long, being almost as long as the ischia, bounding ventrally on each side the elongated obturator foramen. The ischia are expanded posteriorly and on each is a prominent tuber ischii and ischiatic spine, evidently to serve in part for the attachment of strong biceps and semimembranosus muscles.

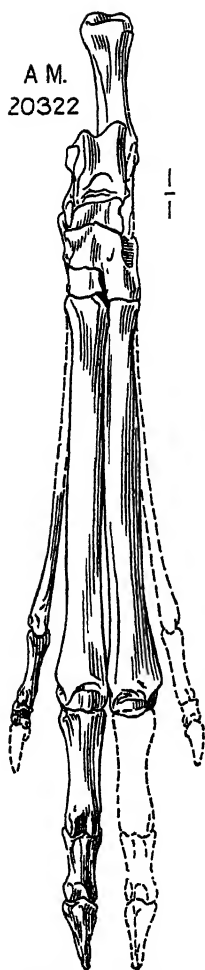


Fig. 3. *Archaeomeryx optatus* Matthew and Granger, Amer. Mus. No. 20322, left pes. Dorsal view, natural size.

The femur of *Archaeomeryx* is actually and relatively large, seemingly more so than in either *Hypertragulus* or *Tragulus*. This would indicate strong hind-quarters and an elevated lumbar and pelvic region—primitive ruminant characters that are retained in the modern *Tragulus*.

The tibia of *Archaeomeryx* is a heavy bone, proportionately heavier than the same bone in *Tragulus*. Its relative length as compared with the femur would seem to be about the same as in *Hypertragulus* and the chevrotain.

In the original description of *Archaeomeryx* Matthew and Granger mention proximal and distal vestiges of a fibula, but these do not appear in any of the material at hand. From the development of the fibular facets on the tibia, however, it would appear that such vestigial elements were present, and in all probability were not connected by a bony shaft.

The pes in *Archaeomeryx* is at once distinguished by the separate third and fourth metatarsals, a primitive condition that is relatively rare among other ruminants, but which is found in *Hypertragulus* and *Hypisodus*. The lateral digits are well developed, but comparatively smaller than the lateral digits in the fore-foot of the same animal, as is in keeping with the principle that the pes in hoofed mammals usually is more specialized than the manus. These lateral toes in *Archaeomeryx* are similar in development to those of *Hypertragulus*, and certainly somewhat larger proportionately than the same toes in *Tragulus*. In the Mongolian genus the cuboid and navicular are fused to form a single element, but the ectocuneiform is separate, a condition similar to that found in the hypertragulids, but more primitive than that characteristic of the Tragulidae and most of the more advanced ruminants, in which the ectocuneiform also is fused to the cuboid-navicular block.

The foregoing discussion may be summarized in outline form as shown below.

THE RELATIONSHIPS OF *Archaeomeryx*

Matthew and Granger placed *Archaeomeryx* in the Hypertragulidae, a position that was accepted by Scott by inference on page 507 of his great monograph of White River artiodactyls. "Except for one genus from the Eocene of Mongolia, the family is of exclusively North American distribution. . . ."¹

In another part of this same work, however, Scott denies the hypertragulid affinities of *Archaeomeryx*, as follows: "By Matthew and Granger, who described and named the genus, *Archaeomeryx* is referred, I think improperly, to the Hypertragulidae,

¹ Scott, W. B., 1940. Trans. Amer. Philos. Soc., N.S., XXVIII, Pt. IV, p. 507.

	<i>Hypertragulus</i>	<i>Archaeomeryx</i>	<i>Tragulus</i>
Size	Small	Small	Small
Skull	Hornless Braincase rel. small Sagittal crest Orbit small	Hornless Like <i>Hypertragulus</i> Sagittal crest Orbit small	Hornless Braincase somewhat enlarged Reduced sagittal crest Orbit somewhat enlarged
Mandible	Comparatively heavy	Comparatively heavy	Lighter
Dentition	U. incisors vestig. U. canine small Post-canine dias. short	U. incisors functional U. canine small Diastema short	U. incisors suppressed U. canine enlarged Diastema elongated
	Cheek teeth brachyodont with large styles.....		Cheek teeth slightly taller, styles reduced
	Lower incisors of equal size.....		Central incisor broad
	Lower canine incisiform.....		Lower canine incisiform
	First lower premolar caniniform.....		P ₁ suppressed
	P ₄ with internal cusp and post. basin.....		P ₄ compressed, trenchant
Axial Skeleton	Back comparatively long, esp. lumbar..... Four sacra..... Tail very long.....		Back shortened Five sacra, fused Tail short
Appendicular Skeleton	Radius-ulna fused Metacarpals distinct Five toes in manus Fibula complete Cuboid-navicular fused Metatarsals distinct	Radius-ulna distinct Metacarpals distinct Four toes in manus Cuboid-navicular fused Metatarsals distinct	Radius-ulna distinct Mc. III-IV fused Four toes in manus Fibula reduced Cuboid-navicular-ectocuneiform fused Mt. III-IV fused

the only supposed member of that family which has, hitherto, been found outside of North America."¹

Matthew and Granger were fully justified in assigning *Archaeomeryx* to the Hypertragulidae, as is evident upon the basis of the osteological characters presented in the original description of the genus or in the preceding pages of this present work. In order to summarize and clarify its hypertragulid relationships, a brief discussion regarding this question will be presented at this place.

In its general size, *Archaeomeryx* is close to the characteristic hypertragulid genus, *Hypertragulus*, as has been noted by various authors. As in the hypertragulids, and the true tragulids for that matter, it is characterized by the raised hind-quarters, due to the relative great length of hind-limb elements as compared with those of the fore-limb. The dentition is typically hypertragulid, except for the fact that the upper incisors are fully developed. But the fact that these teeth may be present,

though reduced, in some of the hypertragulids shows that there was some variability regarding this character within the family, dependent upon the stage of evolutionary development attained by particular genera. The caniniform lower first premolar in *Archaeomeryx* is a very characteristic hypertragulid character.

The general form of the skull of *Archaeomeryx*, is so far as can be determined quite similar to that in the hypertragulids such as *Hypertragulus*—a low, primitive skull with a centrally located orbit. The feet, too, are very similar in the genera being compared. As in *Hypertragulus*, the manus in *Archaeomeryx* has four separate digits (a small fifth toe persists in the American form) the lateral ones of which are of considerable size. In the pes the lateral toes are proportionately smaller, but the central metatarsals remain separate. The cuboid and navicular are in both genera fused into a single bone.

Archaeomeryx is possibly distinguished from *Hypertragulus* by its very long tail, but this is a point of difference of no great

¹ Scott, W. B., 1940. Idem, p. 603.

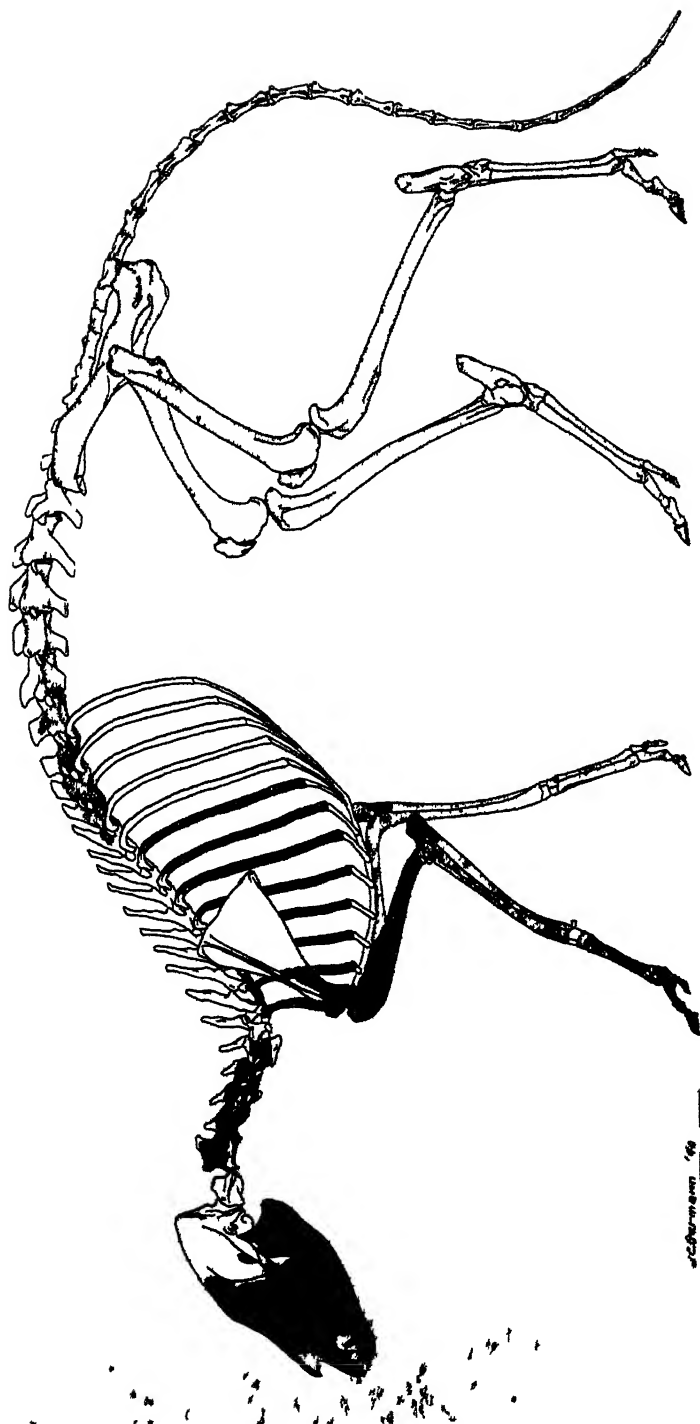


Fig 4. *Archaeomeryx opliatus* Matthew and Granger, restoration of skeleton based upon various specimens in the American Museum, as follows: Skull and jaw from Nos 20321, 20322, teeth from Nos 20311, 20322 and other specimens; cervical vertebrae and scapula from No 20320, dorsal and lumbar vertebrae, sacrum and pelvis, limbs and feet from Nos 20321, 20322, caudal vertebrae from various numbers. Lateral view, one-third natural size.



Fig. 5. *Archacomeryx opalae* Matthew and Granger. Restoration of animal in the flesh. Based upon the restored skeleton as shown in figure 3, and upon analogies with the modern *Tragulus*. Lateral view, one-third natural size.

importance, and certainly cannot be used for excluding the Mongolian genus from the family Hypertragulidae. Unfortunately, there seems to be no very definite information as to the length of the tail in *Hypertragulus*. In *Leptomeryx* the tail evidently was rather short, as might be expected in a form of its general evolutionary stage of advancement.

Consequently, there are numerous arguments favoring the inclusion of *Archaeomeryx* within the Hypertragulidae, and

none of importance that would exclude it from this family. As for its general habitus, the Mongolian genus is seemingly rather close to *Hypertragulus*. It is more primitive in the large upper incisors, the separate radius and ulna, and probably in the very long tail. It is less primitive in certain skull characters, such as the closed orbit, as compared with the open orbit in *Hypertragulus*, and in the general structure of the manus.

TABLE OF MEASUREMENTS, RATIOS AND INDICES

	(1) <i>Hypertragulus</i> <i>calcaratus</i> P.U. 14543	(2) <i>Archaeomeryx</i> <i>optatus</i> A.M. 20322	(3) <i>Tragulus</i> <i>javanicus</i> A.M. 14128
Skull, length, pmx-cond.	85	90e	91
Skull, preorbital length	(41)	37e	40
Skull, postorbital length	(43)	52e	51
Skull, width postorb. constr.	22	..	29
Skull, occiput-basal width	26	..	30
Skull, vert. dia. orbit	(14)	16 5	29
Mandible, length	75	70	74
Mandible, depth at P ₂	10.5	9	7.5
Mandible, depth at M ₃	14	11	11
Mandible, height of condyle	27	26	28
I ¹ ant.-post. dia.
I ² ant.-post. dia.	..	1.1 ¹	..
I ³ ant.-post. dia.	..	1.3	..
C ant.-post. dia.	3	2.2	4
P ¹ ant.-post. dia.	4
P ² ant.-post. dia. × trans. dia.	3	5.9 × 2.9	6 × 2.8
P ³ ant.-post. dia. × trans. dia.	5	6.3 × 3.5	5.5 × 3.9
P ⁴ ant.-post. dia. × trans. dia.	4	4.5 × 5.1	4.4 × 4.8
M ¹ ant.-post. dia. × trans. dia.	5	5.0 × 6.0	4.4 × 5.5
M ² ant.-post. dia. × trans. dia.	5	5.5 × 7.0	5.6 × 6.3
M ³ ant.-post. dia. × trans. dia.	7	6.0 × 7.1	6.4 × 6.5
M ² -height	4	4.0	4.0
I ₁ trans. dia.		2.0	3.8

¹ Upper teeth and lower I-c from A.M. 20321.

	(1) <i>Hypertragulus</i>	(2) <i>Archaeomeryx</i>	(3) <i>Tragulus</i>
I ₂ trans. dia.	..	1.8	0.9
I ₃ trans. dia.	..	1.8	0.8
C ant.-post. dia.	..	2.1	1.7
P ₁ ant.-post dia.	2	2.3	..
P ₂ ant.-post dia. × trans. dia.	3	5	5.8 × 2.0
P ₃ ant.-post dia. × trans. dia.	3	6.2	6.0 × 2.3
P ₄ ant.-post dia. × trans. dia.	4	5.6	5.4 × 2.6
M ₁ ant.-post dia. × trans. dia.	(5 × 3.5	5.8	4.9 × 3.4
M ₂ ant.-post dia. × trans. dia.	6 × 4.5	6.1	6.1 × 4.2
M ₃ ant.-post dia. × trans. dia.	9 × 5) ¹	10.0	8.8 × 4.1
M ₂ height	4.5
Upper premolar series, length ²	12	16.5	16.0
Upper molar series, length	17	18	16.8
Lower premolar series, length ³	13.5	19	16.7
Lower molar series, length	19.5	22.5	19.8

¹ From A.M. 1341.² Not incl. P₁.³ Not incl. P₁.

	(1) <i>Hypertragulus</i> (P.U. 14540)	(2) <i>Archaeomeryx</i>	(3) <i>Tragulus</i>
Length of cervical vertebrae	..	69e	66
Length of dorsal vertebrae	..	150e	113
Length of lumbar vertebrae	..	108	82
Length of sacral vertebrae	..	35	36 ¹
Length of caudal vertebrae (approx.)	..	304e	50+
Scapula, height	54	60e	54
Humerus, art. length	68	72	65
Radius, art. length	58	65	58
Manus, extended length	54	76e	68
Metacarpal II, length	24	29 ²	36
Metacarpal III, length	29	35e	40
Metacarpal IV, length	26	35	39
Metacarpal V, length	22	..	35
Pelvis, length	97	96	90
Femur, art. length	80	90	80
Tibia, art. length	95	101	90
Pes, extended art. length	97	113	105
Metatarsal II, length	39	45	54
Metatarsal III, length	45	54e	58.5
Metatarsal IV, length	44	55	59
Metatarsal V, length	39	..	54

¹ Sacrum = 1st four fused vertebrae, i.e., True sacra S1, S2 + Pseudo-sacra S3, S4.² From 20321.

	(1) <i>Hypertragulus</i>	(2) <i>Archaeomeryx</i>	(3) <i>Tragulus</i>
Ratio preorb. length/postorb. length	95	71	80
Ratio dia. orbit/length skull	16.5	18	32
Ratio U. premolar length/U. molar length	71	92	95
Ratio L. premolar length/L. molar length	70	84	85
Ratio cervical length/dorso-lumbar length	..	27	34
Ratio caudal length/dorso-lumbar length	..	118	(< 100)
Ratio humerus/radius	117	111	114
Ratio humerus/radius + manus	60	51	52
Ratio femur/tibia	84	89	89
Ratio femur/tibia + pes	42	42	41
Ratio metac. II/metac. III	83	83	90
Ratio metat. II/metat. III	87	83	92
Ratio manus/pes	56	67	65

An analysis of the ratios, based upon certain measurements of *Archaeomeryx*, *Hypertragulus* and *Tragulus*, may help to indicate to some extent the developmental trends in these three mammals. Thus the ratio of the preorbital to the postorbital length shows that the eye was most nearly centrally located in *Hypertragulus*—least so in *Archaeomeryx* (although in this latter genus the ratio is undoubtedly not very accurate because of the restoration necessary to bring the skull to a normal, uncrushed state). If a centrally located orbit is indicative of a primitive condition in the unspecialized ruminants, then *Hypertragulus* seemingly is least advanced in this respect. The orbit as shown by the ratios is proportionately small in both *Hypertragulus* and *Archaeomeryx*, which may mean that its much greater size in *Tragulus* is the result of a specialization taking place over a long period of geologic time.

Hypertragulus is distinguished from *Archaeomeryx* and *Tragulus* by the comparative shortness of both its upper and lower premolar series (not counting the first premolar) as compared with the molar series, the last two genera being close to each other with respect to this feature.

In the comparison of the ratios of limb elements, it may be seen that *Hypertragulus* is more primitive than the other two genera by reason of its relatively longer humerus, as compared with the lower fore-leg. But with regard to the length of the femur as compared with the lower portion of the

hind-leg, all three genera are closely comparable.

Hypertragulus and *Archaeomeryx* resemble each other in a comparison of lateral toes with median toes, and curiously enough in both of these genera the lateral toes have undergone more relative reduction than have the same elements in the modern tragulid.

Finally, *Hypertragulus* may be distinguished from the other two genera by the shortness of its manus, as compared with its pes. In this respect, *Archaeomeryx* and *Tragulus* are rather closely comparable.

From this, it would seem that *Hypertragulus* is primitive in various skeletal proportions as compared either with *Archaeomeryx* or *Tragulus*—a conclusion that is borne out to some extent by the expression of certain qualitative characters, such as the presence of a pollex, the open orbit and the like. *Archaeomeryx* seems to show a mixture of quantitative characters, in some respects being like the more primitive *Hypertragulus*, in others like the more advanced *Tragulus*, yet as has been shown in preceding pages, the Mongolian form is especially primitive with regard to various qualitative characters, particularly the presence of three functional upper incisors, an inner cusp on the third upper premolar and a complete lack of fusion of the median metatarsals. Consequently its position must be determined only after a careful survey and a balancing of all of the characters considered in their relationship to each other.

GENERAL DISCUSSION

THE CLASSIFICATION AND PHYLOGENY OF THE RUMINANTS

Matthew and Granger said that *Archaeomeryx* is of particular interest because "it appears to be an approximate ancestral type for the pecora," a statement based upon a careful consideration of the anatomical features of this Eocene genus, which have been outlined in the preceding paragraphs of this paper. In order that the position of the genus may be more thoroughly understood, it may be well at this place to review the taxonomic affinities

of the various families of the "ruminants" thereby establishing a background that will be useful in an interpretation of the osteological study of *Archaeomeryx*.

Various authors have classified the artiodactyls, at best an extremely difficult task, with the result that the so-called ruminants have been accorded a variety of arrangements, some of which will be considered below. Perhaps a comparison of the several most important classifications of the ruminating artiodactyls (and their closely related forms) may be best presented by a

Scott 1940	Schlosser 1887	Zittel and Schlosser 1925	Osborn 1910	Stehlin 1910	Matthew 1929
Ruminantia		Bunosenodontia			Artiodactyla
Tylopoda	Anoplotheriidae Anthracotheriidae	Anoplotheriidae Anthracotheriidae Dichobunidae Selenodontia Xiphodontidae Caenotheriidae Agriochoeridae		Anoplotheriidae (sic) Anthracotheriidae (sic)	Anoplotheriidae Anthracotheriidae
Oreodontoides	Oreodontidae		Oreodonta	Oreodontidae	Caenotheriidae Oreodontidae
Merycoidodontidae			Oreodontidae		
Agriochoeridae					
Cameloides	Tylopoda	Camelidae	Tylopoda	Amphimerycidae Ruminantia Camelidae	Tylopoda Xiphodontidae Camelidae
Camelidae			Camelidae		
Hypertraguloides	Dichobuniden		Tragulina		
Hypertragulidae	Caenotheriidae		Gelocidae		
Protoceratidae	Xiphodontidae	Hypertragulidae	Hypertragulidae	Hypertragulidae	Pecora Amphimerycidae Tragulidae (+ Hypertragulidae) Cervidae Giraffidae (+ Palaeomerycidae) Antilocapridae Bovidae
Tragulina	Tragulidae	Tragulidae	Tragulidae	Tragulidae	
Pecora	Gelocidae (incl. Cervidae, Antilocapridae, Bovidae, Ovidae)	Cervicornia Antilocapridae Cavicornia	Pecora Giraffidae Cervidae Merycodontidae Antilocapridae Bovidae	Pecora	

chart. In this manner a comprehensive view of the essential points of the contrasting schemes of arrangement may be had in a convenient form.

Comparing and synthesizing these various classifications, it becomes apparent that there are two general schemes represented. In the first place, there is the classification of Scott, resting in part upon the tentative and partially expressed ideas of Rütimeyer. According to this idea, most of the North American "ruminants" of Tertiary times represent adaptive radiants of a great suborder Tylopoda. These are constituted in three general groups, the hypertragulids and their relatives, the camelids and the oreodonts. The ruminants having their origin in the Old World are the true tragulines, Tragulina, and the modernized types of the deer, giraffes and bovids, contained within the group Pecora.

As opposed to this, there is the classification formulated by Schlosser and elaborated by Osborn, Matthew and others, according to which the oreodonts are made a separate group, possibly of camelid, possibly of anthracothere relationships, while the group Tylopoda includes only the camelids and their immediate relatives. According to this scheme the hypertragulids are grouped with the "Old World ruminants"—the tragulids, deer, giraffids and bovids.

Scott's classification is based to a great extent upon his acquaintance with the important Uinta fauna, in which there is a large assemblage of primitive artiodactyls. This author has noted how, in tracing back the histories of the indigenous North American "ruminants," the hypertragulids, camelids and oreodonts, a distinct drawing together of these separate lines is seen in their upper Eocene representatives, intimating that at some period not so very much before the beginning of Upper Eocene times there was a common ancestor for all of the various branches of ruminant evolution. Therefore, upon the resemblances each to the other of the upper Eocene representatives of the several supposedly autochthonous Nearctic ruminant groups, Scott regarded them as belonging properly to a single suborder of the Artiodactyla, the Tylopoda.

The opposing scheme, on the other hand, is based upon the differences shown by the characteristic and somewhat more advanced members of the various ruminant groups, rather than upon the resemblances between their ancestral forms. Moreover, this classification is based entirely upon anatomical considerations, and does not take into account the distribution of the ancestral forms—seemingly an important criterion in Scott's arrangement.

There are advantages and difficulties in either of these two general taxonomic schemes, and the validity of either is dependent to a considerable extent upon the individual's philosophy as to the proper criteria of relationships in evolving mammals. Following the various ruminant groups back in geologic time we can see them converging toward each other as we approach the Eocene—as would, of course, be expected among a group of mammals having a common ancestor. In the Upper Eocene, especially in the Uinta fauna of North America, it is possible to see the close approach of many of the ruminant groups to each other, although even in the Upper Eocene ruminants, connected as they are by their resemblances, there already have been established the important diagnostic characters that mark them as members of the several families, of which they are the virtual progenitors.

What then are to be the criteria for a classification of the ruminants? Are certain families to be brought together because of the resemblances of their primitive Eocene representatives, or are they to be separated because of the differences of their post-Eocene, and one might say more characteristic genera? Does the evidence of the ancestral forms justify us in including the indigenous New World ruminants in one suborder, the Tylopoda? Is there to be a complete separation of the New World hypertragulids from the Old World tragulids? Perhaps it may help in this discussion to compare the diagnostic osteological characters of some of the fossil and recent ruminants.

In an evaluation of ruminant characters, it soon becomes evident that certain features are of particular value in comparing

the families throughout the range of ruminant evolution, while other characters may prove to be of little use for this purpose. For instance, although antlers and horns are found only in the pecorans above the tragulids, their presence is not significant in separating the higher ruminants from the more primitive ones because they are of a secondary, sexual nature, and thereby subject to sexual dimorphism within a single species. A similar illustration of this is to be found in the development of the auditory bullae, which at first sight would appear to be useful for establishing family relationships, because in most of the primitive ruminants the bullae are hollow, while in many of the more specialized types they often show an interior cancellous structure. Yet in one family, the Tragulidae, both hollow and cancellous bullae are found, in forms that certainly must be very closely related to each other. (In "*Meminna*," perhaps the most primitive of the surviving tragulids, the bullae are hollow, while in *Tragulus*, and in the African *Hyamoschus* as well, the bullae are cancellous.)

To further complicate this question is the fact that the "ruminant" artiodactyls (including those fossil forms which by a broad interpretation of the term may be included within this division) show various characters or combinations of characters which connect them in different ways to each other. This is important, because it illustrates the inadvisability of relying too heavily upon a few characters, or upon restricted anatomical regions, such as the dentition alone or the feet alone, in attempting to determine relationships within the artiodactyl group. This fact was realized by Matthew, in 1929, who commented upon it as follows: "Study of the skeletons of the better known and later Artiodactyla shows that the characters of the front teeth and of the feet are quite as distinctive and important in determining the relationships as are those of the molars. The resemblances and differences in the foot characters appear to be quite as fundamental as those in the teeth and should be fully considered in working out the natural affinities. It appears to be necessary to evaluate the relationships first of those

genera which are known from complete material and then to associate the imperfectly known genera as best we can."¹

Therefore certain characters have been chosen for use in comparing the various families of ruminants, on the basis of their constancy within a family or within a series of families. These characters may be grouped into three large divisions (in no case is reliance placed completely on single characters), namely, those typical of the ancodont ruminants, those characteristic of the tylopodan ruminants and those developed in the pecoran ruminants.

In the ancodonts, as typified by the anthracotheres, there is a complete dentition, with the upper incisors well developed. The canines are of the generalized mammalian type and the anterior premolars are normal. The cheek teeth are selenodont and not elongated, while in all but the most advanced types the molars retain a protoconule. The feet are short and functionally four-toed, with a complete separation of all the elements. The tail is generally long.

In the tylopodans, as typified by the camels, the dentition may be complete or somewhat reduced; the reduction occurs in the upper incisors and the anterior premolars, but there is never a complete loss of the upper incisors. In the specialized types the lower canine becomes incisiform, while certain anterior premolars tend to become somewhat caniniform. The cheek teeth are selenodont and at a very early stage show a marked tendency toward elongation, with a correlative flattening of their ectoloph or buccal surfaces. The protoconule is characteristically absent. The feet are elongated, very much so in the later types, and they are precociously didactyl, with a fusion of the metapodials to form a "cannon-bone." Curiously enough, the cuboid and navicular remain separate. The tail is short.

In the pecorans, as typified by the deer, giraffes, antelopes and the like, the dentition is always reduced by the suppression of the upper incisors, and usually the first upper and lower premolar. The lower ca-

¹ Matthew, W. D., 1929. Bull. Geol. Soc. Amer., XL, p. 406.

nine is always incisiform. The selenodont cheek teeth are not elongated and are always quadricuspid in the molars. The feet, moderately short in the more primitive types and elongated in the more advanced forms, are quadridactyl but functionally didactyl—since the lateral toes are always much reduced and of little use in locomotion. The median metapodials are fused, as are the cuboid and navicular in the pes. The tail is short.

The question concerning us at this place is how the "intermediate" groups may be fitted into the picture as presented above. It will be remembered that Professor Scott placed the oreodonts and hypertragulids in the Tylopoda, together with the true camels, because of their caniniform first lower premolars and their supposed American community of origin. Most authors have been inclined to place the oreodonts with the anthracotheres in the Ancodonta, and to link the hypertragulids more or less closely with the tragulids, which latter group is either within or closely allied to the Pecora.

The oreodonts are ancodont-like in that they never show a suppression of the upper incisors. In this respect they differ somewhat from the camels, for in the more advanced of these latter animals there is usually a suppression of certain upper incisors, although the process is never carried to completion. The upper canine in the oreodonts is large and characteristically caniniform, and as in most of the other ruminants the lower canine is incisiform and in series with the incisors. But the oreodonts are typified particularly by the enlarged caniniform first lower premolar which functions with the enlarged upper canine, a character that is found somewhat similarly developed in the hypertragulids, and to a lesser degree, in the camelids. On the other hand, the oreodonts are generally ancodont-like in the form of their cheek teeth, a point of some significance, particularly so in the case of the agriochoeres. There may be a protoconule in the more primitive types, but it is generally lost (except in the agriochoeres) in the more advanced forms. The feet in the oreodonts are quadridactyl, actually and functionally,

with separate elements as in the ancodonts. The tail may be long or short.

Turning now to the hypertragulids, we see that these animals are on the whole pecoran-like as to the dental formula. In some of the primitive types, specifically *Archaeomeryx*, the upper incisors may be present, but generally these teeth are reduced to vestiges or completely suppressed. The lower canine is incisiform, while the first lower premolar is always caniniform, occluding with the upper canine when this latter tooth is of any appreciable size. This single character sets the hypertragulids apart in a very definite manner from the Old World tragulids. On the other hand, the hypertragulids are pecoran-like in the loss of the first upper premolar and in the development of the molars, which are quadricuspid, and short, and very similar in their general form and development to the same teeth in the tragulids and other primitive pecorans. The feet in the hypertragulids are also strongly pecoran, being quadridactyl but functionally didactyl, with the lateral toes reduced. In the hypertragulids, in decided contrast to the Pecora, the primitive condition of separate median metapodials holds, except in the most advanced forms. Like the pecorans, there is a fusion of the cuboid and navicular. The tail is long in the primitive types, such as *Archaeomeryx*, but shortened in the more specialized forms.

Whether or not the Old World tragulids are placed within the pecoran group or are separated as a distinct suborder is a matter of individual choice that does not affect the problem now under consideration. Within the categories as delineated above, the tragulids may be considered as primitive but characteristic pecorans, since they show the various features cited as typical of the Pecora. It is only when consideration is taken of more detailed features with which we are not primarily concerned, that the tragulids may be separated from the pecorans.

In conclusion, then, it may be said that a preponderance of oreodont characters link these animals with the typical ancodonts, while a preponderance of hypertragulid characters link these animals with

the pecorans. The one character that links the oreodonts and hypertragulids with the camelids, as advocated by Professor Scott, is the caniniform first lower premolar. Should this character be accorded more weight than the other dental characters, plus the characters of the feet, plus the general habitus of the skeleton?

Turning now to the question of the Upper Eocene ruminants, particularly those from the Uinta formation of North America, we are confronted by the question as to whether they are more like each other than they are like the groups to which they were supposedly ancestral. This problem involves especially the genera *Leptotragulus*, *Protoreodon*, *Protagriochcerus* and *Protylopus*.

Leptotragulus certainly foreshadows very strongly the typical hypertragulids of the Oligocene. It is small, comparable to *Hypertragulus* in size, and in most respects its dentition is typically hypertragulid. Thus the upper molars are quadricuspid, brachyodont, with sharp crescents and large external styles. Indeed, the patterns of the cheek teeth, both in the upper and lower jaws, are strikingly similar in *Leptotragulus* and the hypertragulids. There is a strong internal cingulum. The lower canine would seem to be incisiform, while the lower first premolar, although still retaining two roots, is trending toward a caniniform shape. Even in this early form the diastemata between the cheek teeth and the anterior teeth, so characteristic of the hypertragulids, are present.

This genus is certainly different from *Protoreodon* and *Protagriochcerus*, which show distinct affinities with the Oligocene oreodonts and agriochceres, respectively. Thus, in these genera, the upper molars show curved selenes diverging externally from the somewhat lingually placed protocone and paracone (especially in *Protagriochcerus*), as is characteristic of the "Oreodonta." The protoconule is still present, a character that is carried over into the later agriochceres and some of the oreodonts. The lower canine is completely incisiform, while the lower first premolar is caniniform and considerably enlarged, as in the oreodonts. Moreover, in *Protoreodon* there are

no diastemata between the teeth, another character that very strongly links it with the typical oreodonts, while in addition the shape of the mandible, with its considerably increased depth, is oreodont-like. The feet in *Protoreodon* are short and functionally quadridactyl, an oreodont character.

Protylopus, although showing the numerous primitive characters that might be expected in an Eocene ruminant, nevertheless displays its camelid affinities in a very certain fashion. The skull is long and low, both skull and dentition showing, even at this early stage, the lengthening so typical of the camels. Although the parastyle and mesostyle in the upper molars are still prominent, the ectoloph already shows a considerable amount of flattening, a trend of development continued in an ever-increasing degree in the later camels. Moreover, in this genus the anterior premolars above and below are much compressed from side to side, as in the later camels. The canine is tending to be incisiform, but the first lower premolar, though small, is not truly caniniform. Rather it is elongated and somewhat spatulate, a condition approaching that found in *Poebrotherium*. In the occipital region there is a close appression of the paroccipital process and the bulla, quite as in the later camelids. Finally, the feet of *Protylopus* are strongly didactyl, with the side toes approaching closely the almost complete state of reduction that is found in the later camelids.

Therefore, on the basis of their important characters, it may be said with confidence that *Protoreodon* is an ancestral oreodont, *Protagriochcerus* an ancestral agriochcer, *Protylopus* an ancestral camel and *Leptotragulus* an ancestral hypertragulid. Moreover, the oreodont, camelid and hypertragulid characters of these Uinta genera are so strongly marked that one may be justified in saying that by Upper Eocene times the trends of ruminant evolution were established to such a point that the genera of this age were diverging away from each other towards the habitus of their various descendants in a most decided fashion. In other words, although the primitive heritage characters are still present in the Upper Eocene ruminants, it is

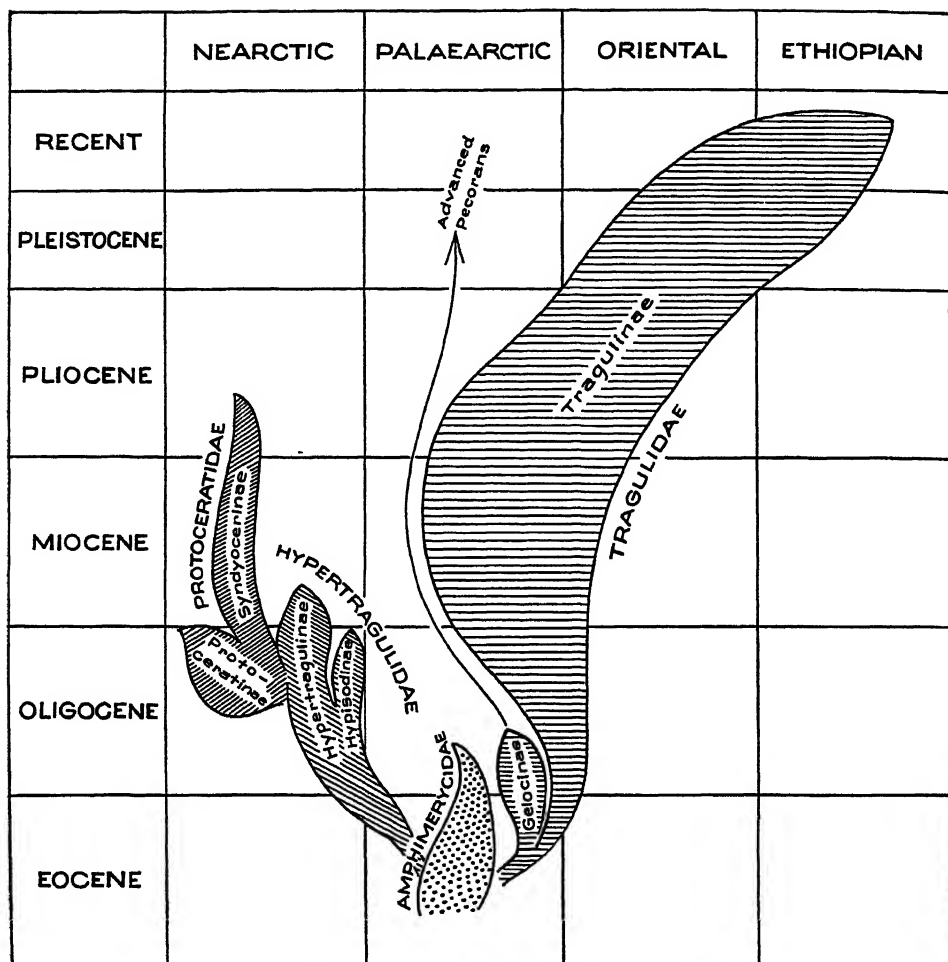


Fig. 6. Phylogeny of the primitive ruminants.

the beginning of their specialized habitus characters that make them distinctive as genera.

If this is the case, if the bulk of characters in the skull, teeth, feet and body point to the distinctness of the Upper Eocene genera constituting the oreodonts, camelids, hypertragulids and other ruminant families of that day, what is the value to be placed upon the caniniform first lower premolar, which has been used as a character pointing to the close relationship of the first three groups named?

A caniniform first lower premolar, in a

greater or lesser degree, is not at all uncommon among the early Artiodactyla, as an examination of Eocene genera will show, and there is reason to think that such a structure might have been independently developed in various families belonging to this order. It is most highly developed in the Hypertragulidae and the oreodonts, as Scott maintained, while its expression in the camelids is considerably less pronounced than is the case in the two other families cited. But it is also found in certain primitive bunodont artiodactyls of dichobunid relationships, notably in the

European forms *Cebochoerus* and *Choeropotamus*, and perhaps in the Mongolian genus *Gobiohyus*—although in this latter animal the tooth in question is not so much caniniform as it is small, and single rooted. A similar small, single rooted P_1 was present in some of the American dichobunids, such as *Lophiohyus* and *Diacodexrus*.

But to consider only those forms in which the first lower premolar actually functions as a canine in opposition to the upper canine, it is at once evident that the tooth has been derived independently in the European dichobunids as compared with the American Hypertragulids and oreodonts. For in the European forms it is generally doubly rooted, with an elongated base, as compared with the rounded, single-rooted tooth so characteristic of the oreodonts and hypertragulids. The caniniform P_1 in the oreodonts is of quite different form from that in the hypertragulids and this difference extends to the Eocene genera, *Protoreodon* on the one hand and *Leptotragulus* and *Archaeomeryx* on the other. In the hypertragulids the caniniform P_1 is invariably rounded in cross-section, sharply pointed and erect. In the oreodonts it is laterally compressed, with a strong ridge on the front and on the back surface, and it is generally rather procumbent. Whether these differences are to be regarded as divergences from a single origin, or as expressions of two independent origins is a question that in itself cannot be solved. But taking into account the numerous ancodont-like characters in the skull, dentition and skeleton of the oreodonts, and the numerous pecoran-like characters in the skull, dentition and skeleton of the hypertragulids, there is more than a faint reason to suspect the caniniform P_1 as being due to an independent origin in the two groups.

If the resemblances and differences discussed in the foregoing paragraphs are

significant, then the hypertragulids may be regarded as an essentially New World branch of primitive ruminants, closely related to but somewhat divergent from the Old World Tragulidae. Indeed, the discovery of *Archaeomeryx* in Mongolia would seem to point to the probability of an eastern Palaearctic origin for the Hypertragulidae, perhaps in common with that for the Tragulidae. The Hypertragulidae may be a New World development of the ancestral pecoran stock, just as the Tragulidae are the Old World expression of this same stock. Having separated, the Hypertragulidae gave rise to the aberrantly specialized Protoceratidae, both families becoming extinct, while the Tragulidae were ancestral to the deer, giraffids and bovids, all of which groups proved to be extraordinarily successful.

With the above considerations in mind, the tragulines might be placed among the ruminants and related artiodactyls somewhat in the following manner.

Order Artiodactyla

Suborder Ancodonta

Superfamily Anthracotherioidea
Oreodontoidea

Suborder Tylopoda

Superfamily Cameloidae
Family Xiphodontidae
Camelidae

Suborder Tragulina

Superfamily Amphimerycoidea
Family Amphimerycidae
Superfamily Hypertraguloidea
Family Hypertragulidae
Subfamily Hypertragulinae
Hypisodinae
Family Protoceratidae
Subfamily Protoceratinae
Syndyceratinae

Superfamily Traguloidea
Family Tragulidae
Subfamily Tragulinae
Gelocinae

Suborder Pecora

Superfamily Cervoidae
Giraffoidea
Bovoidea

CONCLUSIONS

1.—On the whole, *Archaeomeryx* is probably the most primitive ruminant (to use this word in its more restricted sense) of which the osteology is fairly completely known. It is not as primitive as *Amphimeryx*, in that this latter genus still retains a protoconule, which is lost in *Archaeomeryx*. However, so little is known of *Amphimeryx* beyond the dentition that it is not possible to gain any very adequate idea as to the general habitus of this animal.

2.—*Archaeomeryx* is a member of the family Hypertragulidae, and in most of its anatomical characters it is rather close to *Hypertragulus* itself. In certain characters, such as the development of the upper incisors and the possession of a very long tail, it is more primitive than *Hypertragulus*; in a few, such as the closed orbit and the four-toed manus, it is less so.

3.—Both *Archaeomeryx* and *Hypertragulus*, although resembling each other closely, also show many resemblances to the Old World *Tragulus* which because of their number and character would seem to be due to more than mere convergence. Most of the differences between these typical hypertragulids and *Tragulus* are of secondary importance in that they represent minor specializations that have taken place in the Old World form during the long geological period through which it has persisted. Such are the somewhat enlarged braincase and the enlarged orbit, complete loss of the upper incisors, enlargement of the median lower incisor, somewhat greater hypsodonty and reduction of styles in the cheek teeth, the relatively shorter lumbar section, the fused sacrum, the shortened tail, and fusions in the feet, specifically between the median metapodials and the cuboid-navicular-ectocuneiform in the tarsus. The one difference of great significance between the hypertragulids and the tragulids is the caniniform first lower premolar in the former, which is to be compared with a very small tooth in some of the fossil tragulids and a complete suppression of it in the recent genera. Undoubtedly the development of this tooth points to the early separation of the two families from a common ancestor, probably of late Eocene age, with

the result that they followed separate but parallel courses of evolutionary development.

4.—Nevertheless, the numerous resemblances between the Hypertragulidae and the Tragulidae constitute strong evidence for the relationship of these families with each other, as descendants of a common ancestor. So it is that by looking at a modern *Tragulus* we are able to gain a fairly comprehensive idea as to the habitus of the ancestral pecoran of Eocene age. If *Archaeomeryx* could be restored and brought to life and placed beside a modern chevrotain, the two would look superficially very much alike, the main differences externally being in the somewhat longer back, the very long tail and the lack of a canine tusk in the Eocene genus. Other differences of taxonomic importance, such as the retention of the upper incisors and the caniniform first lower premolar in the fossil form, would not be noticeable.

5.—In any consideration of artiodactyl relationships it is necessary to consider the sum of characters that are of diagnostic importance, for single characters may be dangerously misleading when applied in this complex group of mammals. This is particularly true among the ruminants, where families may be combined in a variety of ways upon the basis of single characters. Therefore, upon the basis of as many characters as it is possible to use in a consideration of fossil and recent forms, it seems evident that the relationships of the hypertragulids are with the true tragulids and pecorans, rather than with the camels.

6.—It is quite probable that the ancestral pecoran lived in the Palaearctic region, possibly in Central Asia, a conclusion supported by the presence of the Amphimerycidae, the most primitive of the ruminant group, in Europe, and of *Archaeomeryx*, a very primitive type, in Central Asia. From the ancestral pecoran stock two early lines diverged, namely, those represented by the Hypertragulidae and by the Tragulidae. The Hypertragulidae, it would seem, at a very early stage in their history migrated from Asia into North America,

where they flourished for a relatively short time and then died out, but leaving as their descendants the rather aberrant Protoceratidae, a group that also was destined to ultimate extinction. The Tragulidae, on the other hand, continued in the Old World, where they have been quite successful, not only in their own limited evolutionary development but in their legacy of specialized ruminants which now dominate the Holarctic mammalian faunas. At an

early stage there was a division of the Tragulidae into two phylogenetic lines. One of these was that of the Tragulinae, which has continued to the present times with but little evolutionary change. The other was that of the Gelocinae, which at an early date showed a trend towards the habitus of the higher pecorans, and very probably was directly ancestral to the deer, giraffes and bovids.

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LARGE PLEISTOCENE FELINES OF NORTH AMERICA

BY GEORGE GAYLORD SIMPSON

About thirty occurrences of true cats, felines, of the size of pumas or larger have been reported in the Pleistocene of North America. Except for the specimens from the asphalt of Rancho La Brea and of McKittrick, in California, these are nevertheless relatively rare fossils and the specimens are usually fragmentary. They have been assigned by various students to about fifteen different species and their affinities and taxonomy have not been understood. Many have been placed in extinct, or supposedly extinct, species with no definite idea as to their relationships to other cats. A few have been recognized as pumas, or as related to pumas, but on the other hand some that are pumas beyond much doubt have been sharply separated from that group. Others have loosely been called "lions" or "tigers" without clear demonstration of a reason for such explicit terms and in spite of the fact that they are related only remotely and not in any exclusive way to those Old World forms. There has indeed been a general tendency to compare our larger fossil felines with those of the Eastern Hemisphere and to minimize or omit entirely comparisons with other American cats, in spite of the fact that the latter comparisons would seem more obvious and are in most cases, perhaps in all, truer indications of affinity. It is particularly striking that (with one cryptic and unexplained partial exception, noted later) no one seems to have reported jaguars in the Pleistocene of the United States and few have seriously considered this rather obvious possibility.

It is the purpose of the present paper to make a summary review of these discoveries and to attempt to establish some order in this confusion. As usual, many problems remain unsolved and not all loose

ends can be gathered, but on present evidence it seems possible to establish the following conclusions:

1.—Known large Pleistocene felines from North America suffice to demonstrate the presence of three, and only three, groups: pumas, jaguars, and *P. atrox*.

2.—Although scattered from the Atlantic to the Pacific Coasts, the Pleistocene pumas do not, in the known parts, show much if any more variation than do recent pumas of one subspecies and of more limited geographic distribution. They average a little larger than recent pumas and show minor morphologic distinction of not more than specific value and possibly less. The definitions of the several supposedly distinct groups are not yet satisfactory.

3.—True jaguars specifically inseparable from *Panthera onca*, the living species, occur widely. They may (doubtfully) average somewhat larger than the largest living races and may be tentatively distinguished as *P. onca augusta*. No local differences within North America are demonstrated by the known materials.

4.—*Panthera atrox*, the so-called American lion, is not a lion and might be called a giant jaguar, clearly distinct specifically from *P. onca* but nevertheless related to it.

The evidence for these views will be briefly summarized in this paper.

As acknowledged in more detail elsewhere,¹ I am much indebted to Dr. W. J. Cameron and Mr. W. E. Michael for the specimens of fossil jaguars from Tennessee described in this paper. I am also indebted to Dr. C. L. Gazin for the opportunity to study several types and other specimens in the collection of the U. S. National Museum, for the loan of an important, undescribed specimen collected by J. W. Gidley in Florida, and for permission to describe and figure this specimen here. The Department of Mammalogy of this Museum has provided a large number of recent specimens for comparison. Dr. Anne Roe

¹ Amer. Mus. Novitates, No. 1131.

Simpson has read the manuscript and offered useful suggestions on several points.

The drawings in this paper were made by J. C. Germann.

NORTH AMERICAN FOSSIL JAGUARS

The certain identification and determination of the affinities of the large cats demand associated dentitions, at least, since even forms as dissimilar as jaguars and pumas are much alike as regards isolated teeth or many skeletal fragments. It is probable that specimens described as long ago as 1872 and at intervals since then are, in fact, jaguars, but only now is it possible to prove that these animals did live in North America, well outside their present range, during the Pleistocene. Various American fossils have been compared with jaguars, as well as with lions, tigers, and other forms in reality more distantly related, but a positive identification is now made possible for the first time by three relatively good specimens, Amer. Mus. Nos. 32633 and 32635 and U.S. Nat. Mus. No. 11470.

These American Museum specimens were found in Craighead Caverns, near Sweetwater, Tennessee. An account of their discovery and peculiar occurrence is being given elsewhere and need not be repeated here.¹ Amer. Mus. No. 32633 (Fig. 1) includes the right ramus of the lower jaw, lacking the incisors, which had dropped out after death, and the coronoid process and medial portion of the articular condyle, gnawed off by rodents. The symphyseal portion of the left ramus, with the canine but without the incisors was also found. The symphysis was open and the two sides separated, although they certainly belong to one individual. Posterior to the canine the left ramus had been broken and the surface is gnawed. There is a slight rim of calcareous material near this break and it has been suggested that this represents healing of a jaw fractured during life, but I think it more probably post-mortem and representative of contact with the surface of the dirt, the protruding part having been gnawed away. The cheek teeth show considerable wear but the cusp

arrangement is still well visible. The right canine had apparently been broken off during life and the stump later much worn by use—this is a common occurrence among recent jaguars. The left canine had not been broken, unless possibly at the tip, but is also much worn, especially on the posterior side.

This jaw considerably resembles *Panthera atrox*, indeed it probably has no morphological characters that do not occur as variations in that species, which is very jaguar-like in this part and most others. It is, however, significantly smaller than any of the fine series of *P. atrox* jaws now known, even if the relatively small "*Felis imperialis*" be included in *P. atrox* as Merriam and Stock suggest and as I also think proper.

In every character, including size and proportions, the fossil jaw closely approaches the largest living jaguars. Comparisons were made especially with a series of eight recent specimens of *Panthera onca milleri*, which is among the largest, but is not the largest, of recent groups. All strictly morphological features of the fossil can be almost exactly matched in this subspecies. The fossil jaw is slightly deeper (not longer), but not significantly more deep in a statistical sense, than in large males of the recent group. The canine is unusually stout, but again the difference is slight and not significant. The cheek teeth are not significantly wider, but are significantly longer both absolutely and relatively, although the difference from the largest *milleri* males is not great. They compare as follows:

Variate	<i>P. onca milleri</i> (N = 8)		d of Amer. Mus. No. 32633 from <i>milleri</i>	d/ σ'
	Mean	σ'	mean	
LP ₁	15.19	.99	3.01	3.0
LP ₄	21.26	.86	3.44	4.0
LM ₁	21.16	1.25	3.44	2.8

¹ Amer. Mus. Novitates, No. 1131.

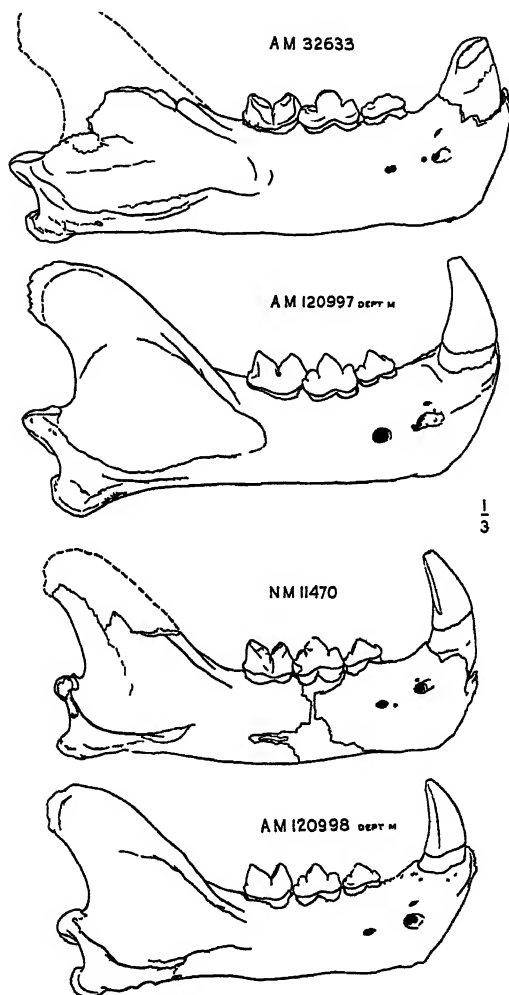


Fig. 1. Lower jaws of fossil and recent jaguars. A.M. No. 32633, *Panthera onca augusta*, presumed male, subfossil, Craighead Caverns, Tennessee. A.M. No. 120997 (Dept. Mammalogy), *Panthera onca milleri*, male, recent, Matto Grosso. N. M. 11470, *Panthera onca augusta*, presumed female, fossil, Melbourne Formation, Melbourne, Florida. A.M. No. 120998 (Dept. Mammalogy), *Panthera onca milleri*, female, recent, Matto Grosso. All one-third natural size.

I do not have an adequate series of the largest living subspecies, *P. o. palustris*, but the lengths of these teeth in the Tennessee fossil are probably within the range for that subspecies, surely so as regards M_1 for which Cabrera (1934) has given ten measurements. For this series $M = 22.80$, $\sigma' = 1.18$, d for the Tennessee specimen = 1.8, and $d/\sigma' = 1.5$, far from significant. On the available data I do not, indeed, find any way to distinguish this fossil from the large living males of *P. o. palustris*.¹

Amer. Mus. No. 32635 (Fig. 2) was also found in Craighead Caverns and in the same fissure as the jaw just discussed, although some distance from it and higher in elevation. The teeth are less worn and

including their palatal processes, and the anterior part of the jugal and a fragment of the right nasal are also preserved. Near this and apparently belonging to the same individual were found the nearly complete zygomatic process and a small part of the articular process of the left squamosal and another piece with much of the right ear region, including the inner half of the glenoid fossa, post-glenoid and post-tympanic processes, adjacent parts of the squamosal, outer and anterior parts of the tympanic, and the complete petrosal.

Like Amer. Mus. No. 32633, these parts agree very closely with recent jaguars and are in all respects near or within the known range of variation of large males of *P. onca*

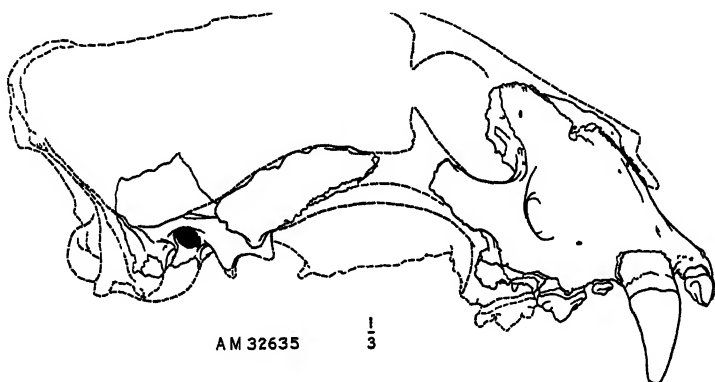


Fig. 2. *Panthera onca augusta*, restoration of right lateral view of skull, probably male. Parts in continuous lines are Amer. Mus. No. 32635, from Craighead Caverns, Tennessee. Zygomatic fragment is reversed from the left side. Parts in broken lines restored with reference to recent *Felis onca* skulls. One-third natural size.

do not occlude well, so that this specimen probably represents a second individual. The right side of the face is represented, with I^{1-3} , C, and P^{2-3} . The premaxilla and maxilla are practically complete, in-

palustris or *P. o. milleri*. In the upper dentition (unfortunately lacking the characteristic carnassial) the only definite distinction from our *P. o. milleri* series is the greater length of P^2 , 8.5 mm. as opposed to 7.28 mean and 7.7 maximum observed

¹ This is the subspecies usually called *Panthera onca paraguayensis*. On the nomenclature of this group see Cabrera, 1934. Incidentally Cabrera notes that the whereabouts of the type of *Felis onca antiqua* Ameghino, 1889, is unknown to him and he discusses this form on the basis of a cast. The original was sold by Ameghino to Cope and by Cope to this Museum, where it is now permanently preserved as fossil mammal No. 11107. I have examined it and agree with Cabrera's conclusion that it is inseparable from *P. onca palustris*.

The subspecific separation of *P. onca milleri* from *P. o. palustris* is uncertain, although *milleri* does represent a local group, race or stirps, with slightly different average characters.

Throughout this paper all recent jaguars are considered as belonging to one species, *Panthera onca*, following Nelson and Goldman, 1933, and other good recent authorities. The living pumas are similarly all referred to *Felis concolor*. In both these cases the degree of divergence and the character of distribution is typically that of geographic races and subspecies, not of several well-defined full species according to the best usage.

Finally on the subject of nomenclature it is noted that the name *onca* should be pronounced "onaa" and not "onka," but the otherwise preferable spelling *onca* is not permissible because Linnaeus wrote *onca*.

in our recent series of eight specimens. Although small, the difference is significant ($d/\sigma' = 3.7$) and the race represented by the fossil did have a larger P^2 than does this recent race, both absolutely and relative to the width of the same tooth. It may not have differed significantly from *P. o. palustris* which has on an average a larger dentition than *milleri* and for which I do not have an adequate series of measurements of P^2 . There are no other apparently significant differences in size or structure of the dentition.

The osteology of the preserved parts of the face appears to be within the range of either of the recent subspecies mentioned and, except for size, of recent jaguars generally. An interesting feature is the presence of a shallow, irregular pit on the maxillo-nasal suture immediately posterior to the ascending process of the premaxilla. This apparently represents a puncture, such as would be made by the canine of another jaguar, healed during life. Such scars are very common among recent jaguars, usually on males, to such an extent that they could almost be considered as secondary (or tertiary) sexual characters. All of our wild-collected and definitely sexed male *milleri* skulls have such head scars, in one case (Dept. Mam. No. 36950) in almost the same position as in the fossil. None of the definitely sexed or probable females has similar scars. Although obviously inconclusive, this is serious evidence that the fossil is a male, a matter of some taxonomic importance as will appear.

The zygomatic process of the squamosal is not very characteristic and requires no more comment than to say that it is almost exactly like the same part in large recent jaguars. The rugosities on the temporal surface of the root are a little more prominent than in my comparative specimens, but this has no apparent significance.

The auditory region, on the other hand, has great value in determining affinities despite the fact that it shows a surprising amount of variation. For instance, the degree of application of the mastoid process to the bulla gives rise to striking differences. The two are sometimes smoothly continuous and sometimes separated by

a groove which may be deep or shallow, broadly rounded or narrow and fissure-like. But all these variations may occur (among jaguars, at least) not only in one subspecies but also in one interbreeding local stock. Indeed in one of the female *milleri* specimens this character is markedly different on the two sides of the same skull. (The fossil has a broad groove with rounded bottom and of moderate depth.)

Here again this part is basically jaguar-like throughout in the Craighead cat. The distance from the post-glenoid process to the posterior part of the mastoid process is shorter and the lateral exposure of the mastoid process is smaller than in recent comparative specimens of similar size, but the difference is so slight and the variation so great that this observation has no necessary significance. Another unusual but not unique feature of doubtful significance is the clarity and size of a pit (foramen spinosum?) anterior to the external auditory meatus and immediately medial to the post-glenoid process, and the development from the tympanic of a prominent spine medial to this.

Found near these skull parts was the articular end of a right scapula, Amer. Mus. No. 32638, and a left second metatarsal, Amer. Mus. No. 32637. These also belong to a jaguar and probably to one of the individuals represented by the jaw and skull parts (or possibly, but improbably, all are of one individual), but association is not demonstrated. The scapula has been much gnawed by rodents. As far as can be judged by what remains, which is characteristic enough for fair identification, it closely resembled the same part in a large recent jaguar. The metatarsal is perfectly preserved and is particularly valuable because the metapodials are among the most characteristic parts of the jaguar and permit unequivocal identification at least as far as the species. This specimen is decisively like *P. onca* in all important respects. In comparison with my limited recent material, the mesocuneiform articular surface extends farther on the head in a plantar direction, the process that abuts against the first metatarsal is more prominent and more distal, and the shaft is less

curved. These small differences in variable features are outweighed by the general agreement, especially since the available comparative specimens are from zoo animals and the slight differences do not constitute definite resemblances to other known species.

The principal measurements of this bone are as follows:

Greatest length.....	84.2 mm.
Dorsoventral diameter on outer face of proximal end.....	20.6
Greatest transverse diameter of articulation on proximal end.....	12.2
Least transverse diameter of shaft.....	11.9
Transverse diameter of distal end of shaft.....	16.6

like *P. atrox*, and quite different from the puma.

Taken together, the Craighead Caverns specimens include many fully identifiable features and leave no possible doubt that they do represent a jaguar inseparable from *Panthera onca*, if that species be used to include all recent jaguars as is now generally done.

This positive identification and spread of material for comparison makes possible the more tentative identification of various similar but less complete specimens found previously. Of these by far the best is U.S. Nat. Mus. No. 11470, collected by

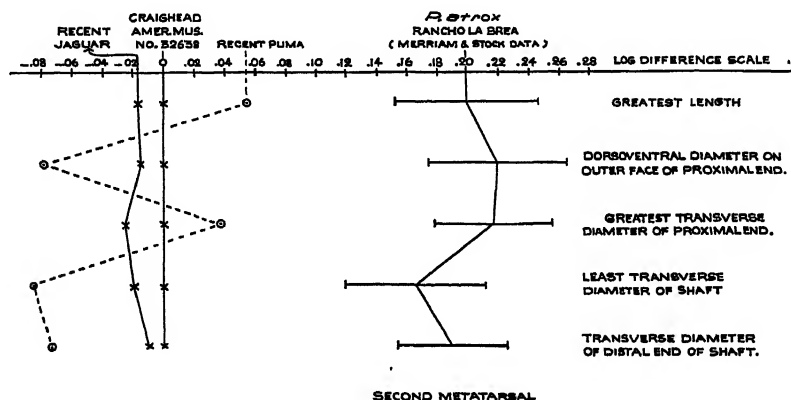


Fig. 3. Ratio diagram of dimensions of second metatarsal in various large felines, as labeled. Recent jaguar and puma, one specimen of each in American Museum. *P. atrox*, large Rancho La Brea sample, data from Merriam and Stock; horizontal lines show observed ranges. For method of construction and interpretation of this and other ratio diagrams (Figs. 6-10) see notes at end of text.

The accompanying ratio diagram, Fig. 3, compares the proportions of this bone to homologous elements in some other cats. The construction and interpretation of such diagrams are explained at the end of this paper. It is noted there that (with the arrangement used in this figure) closer approach to a single vertical line of observations on a form used for comparison means closer approximation of proportions to those being compared, which are arbitrarily set in a straight vertical line. The diagram therefore shows that the proportions of the Craighead metatarsal are almost exactly as in the recent jaguar, somewhat, but less,

the late Dr. J. W. Gidley at Melbourne, Fla., in 1926 but not hitherto published. It is not exactly labeled as to horizon but doubtless came from the "No. 2 bed" or Melbourne Formation, considered by Hay to belong to the first interglacial stage but by most other students believed to be late or latest Pleistocene. This specimen is included in this study through the courtesy of Dr. C. L. Gazin. In a list of Melbourne fossils prepared by Gidley and published by Hay (1927) the entry "*Felis centralis*" appears without comment. "*Felis centralis*" is the Central American jaguar, *Panthera onca centralis*. Gidley's label

on this specimen is "*Felis cf. veronis* Hay," but it is probably the basis for his queried identification as *F. centralis*. Both identifications appear to me to be correct to the point of recognizing the specimen as a jaguar and placing *F. veronis* also in that group.

The specimen is a right lower jaw with the canine and P_3-M_1 , the central part of the ramus somewhat broken, the incisive region and tip of the coronoid broken away and lost, and the ends of the articular condyle abraded. This animal certainly is a jaguar and is in every respect within the known range of living *Panthera onca*. It can be almost exactly matched among recent specimens. It is smaller and more lightly built throughout than the Tennessee jaw and these characters, together with the rather feeble carnassial, do make it resemble the small race *P. onca centralis* as Gidley's apparent identification implies. Nevertheless it is possible and I think probable that it belongs to the same group as the notably more massive Craighead Caverns cats. Recent jaguars, as well as the Old World species of *Panthera*, show marked sexual dimorphism, the females being smaller and more lightly built than the males. The differences between this Melbourne specimen and those from Craighead Caverns are about what would be expected if the former were a female and the latter a male. For instance, as is evident in Fig. 1, the Melbourne specimen agrees closely with rather large females of *P. onca milleri* and the Craighead Caverns specimens similarly agree with large males of the same subspecies. Moreover, as will be shown, "*Felis veronis*" is a form comparable in size with that from Craighead Caverns and this supposed species certainly lived in direct association with this Melbourne cat. These facts seem to me to admit no other reasonable interpretation than that U. S. Nat. Mus. No. 11470 is a female of "*F. veronis*."

Felis veronis Hay, 1919, was based on an isolated left P^4 from Vero, Florida, in the same bed as the Melbourne jaw but at a different locality. Since the jaguar specimens hitherto discussed do not include P^4 direct comparison is impossible. Hay com-

pared this specimen with the (Asiatic) tiger and the jaguar and, while he did not definitely commit himself, he seems to have felt that it was closer to the tiger.¹ He said that it differed from the jaguar in the presence of a "preanterior tubercle," less reduced protocone, relatively lower main cusp, and greater size. These distinctions are all invalid. Within a single subspecies, recent jaguars may lack the "preanterior tubercle" on P^4 or may have one notably larger than in the type of *F. veronis*. The development of the protocone averages about as in *F. veronis* and may be greater or less. In the series of *P. onca milleri* skulls the relative height of the main cusp of P^4 is almost exactly as in *F. veronis*. Although Hay's type is at about the maximum known size for P^4 in recent jaguars, it is within the range of the large race *P. onca palustris*, in which the length of this tooth reaches at least 33 mm. (Cabrera), which is the length of the type of *F. veronis* (to two significant figures).

It is difficult and occasionally impossible to distinguish recent feline species from isolated P^4 alone, so that demonstration that there is no definite distinction between this tooth in *F. veronis* and in *P. onca* does not absolutely demonstrate an identity. It is, however, very suggestive. *F. veronis* is significantly smaller than *P. atrox* and significantly larger than any known fossil or recent pumas. Such North American specimens as are of comparable size and more definitely identifiable now prove to belong to *P. onca*. Moreover *P. onca* is now shown to occur at the same horizon as the type of *F. veronis* and at a nearby locality. All these considerations make it as nearly certain as may be without the discovery of more complete upper dentitions that *F. veronis* is a jaguar doubtfully or not separable from *Panthera onca*.

The animal to which the type of *F. veronis* belonged was of about the size of the large lower jaw from Craighead Caverns. In eight specimens of *P. onca milleri* the ratio length M_1 : length P^4 ranges from .74 to .79, mean .755. M_1 in the Craighead cat is 24.6 mm. in length, so that its P^4 was about

¹ In subsequent non-technical accounts he called it a tiger, without other specification.

33 mm. in length, with a possible range of about 31 to 33½. P⁴ of *F. veronis* is 33 mm. long, and hence suited to be the upper carnassial of an animal of the size of the Craighead cat as is also evident in Fig. 4.

F. augustus Leidy, 1872, was based on a small fragment of upper jaw with P⁴ and

rence in the Miocene of a species of the recent genus *Felis*, even *sensu latissimo*, is evidently anomalous but has not been the subject of very explicit comment. It was perhaps on this basis, and certainly not from examination of the specimen, that Matthew (e.g., 1909, p. 116) referred the

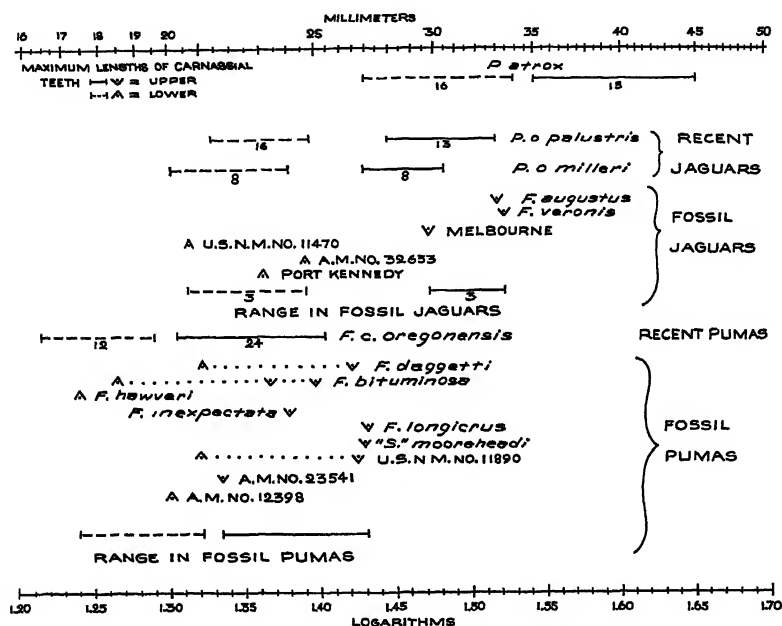


Fig. 4. Logarithmic plot of absolute lengths (not ratios) of upper and lower carnassials in various large felines, as labeled. Dots in carets represent single specimens, horizontal lines groups of specimens, their number given below the line. *P. atrox*, sample from Rancho La Brea, data from Merriam and Stock. *P. o. milleri*, living in Matto Grosso, American Museum specimens. *F. augustus*, type. *F. veronis*, type. Melbourne, unnumbered specimen from that locality in U.S. Nat. Mus. U.S.N.M. No. 11470, also from Melbourne. A.M. No. 32633, the Craighead Cat. Port Kennedy, specimen from the locality referred to *F. inexpectata* by Cope. *F. c. oregonensis*, living in northwestern U. S., includes some specimens referred to *F. c. hippolestes*, data from C. H. Merriam and from J. C. Merriam and C. Stock. *F. daggetti*, type and referred, data from Merriam and Stock. *F. bituminosa*, type and referred, data from Merriam and Stock. *F. hawveri*, type, data from Stock. *F. inexpectata*, type, data from Cope. *F. longicrus*, type. "S." *mooreheadi*, type. U.S.N.M. No. 11890, from Cumberland Cave, data from Gidley and Gazin. A.M. No. 23541, from Seminole Field, Florida. A.M. No. 23541, from Conard Fissure, referred to "*F. cougar*" by Brown.

(Logarithmic plotting is used because it represents equal relative variation by equal horizontal distances.)

the middle and posterior parts of P³, collected by F. B. Hayden on the Niobrara River, Nebraska. It was described as from the "Loup Fork" and as of Miocene age. This age assignment appears to have gone unchallenged ever since and has prevented the careful comparison of the specimen with the large Pleistocene felines. The occur-

species questionably to "*Machaerodus*," a genus to which it cannot possibly belong.

The apparent explanation of the anomaly is that the age assignment, not the generic assignment (*sensu lato*), is wrong. Leidy's "Loup Fork" materials included specimens from several quite distinct horizons, ranging from Miocene to Pleistocene

in age. The present specimen can be referred to the Pleistocene with little question, on this evidence:

a.—Some unquestionably Pleistocene specimens were recorded in the same way.

b.—The preservation of this specimen is distinctly unlike that of any truly Tertiary specimens from the same region and like that of some Pleistocene specimens.

c.—In the enormous collections subsequently made, nothing at all like this animal has turned up in the Tertiary but there are now a number of specimens known to be from the Pleistocene (or possibly early post-Pleistocene) that are specifically indistinguishable from this.

Like the type of *Felis veronis*, this specimen is not very exactly determinable in itself but a general comparison of all the materials establishes the probability that it belongs to the same group as *F. veronis* and hence that it is one of the large Pleistocene North American jaguars. When Hay described *F. veronis* he said that *F. augustus* "differs in various ways from the Vero specimen," without saying in what ways and obviously depending on the supposed difference in age rather than on actual comparison. Such comparison is necessary now that the two are seen to be of approximately the same age.

P⁴ is of almost precisely the same length in the two types, 33.1 mm. in the type of "*Felis augustus*" and 33.4 mm. in the type of "*Felis veronis*," but the latter is wider, 18.7 mm. as opposed to 16.7 mm. In keeping with this lesser width, the protocone in the type of "*F. augustus*" is smaller and it is directed somewhat more anteriorly. The anteroexternal cuspule is slightly smaller. The anterior border is emarginate between the protocone and the parastyle.¹ These and greater distinctions occur between different individuals of a single race of living jaguars, and the two fossils are otherwise almost identical in size and structure. In our very homogeneous *milleri* series the observed range (for only eight specimens) of the length:width index for P⁴ is 173–200. The difference in this respect between "*F. veronis*," index of type 179, and "*F. augustus*," index of type 198, is therefore not enough, in itself, to demonstrate or suggest even a local racial

difference, still less to validate specific separation. Of course a difference in the average characters of groups, corresponding with local racial distinction, is not excluded, but the specimens now available show that the two are very closely related and do not permit any valid taxonomic distinction, so that there is little choice but to consider the two names as synonymous.

In the U.S. National Museum collection there are two uncatalogued specimens of P⁴, both broken, of an essentially similar feline, collected at Melbourne, Florida, by J. W. Gidley. One is 29.6 mm. in length and the other, on which this dimension cannot be exactly measured, was about 33 mm. in length. Both have the anteroexternal cuspule vestigial or absent, thus tending to eliminate this apparent difference from "*F. augustus*," and in one the protocone, although broken, evidently projected forward as in "*F. augustus*." The specimens are from the same bed as the type of *F. veronis* and from a nearby locality and they tend to support the synonymy of that name with *F. augustus*.

Freudenberg (1910) described a left ramus with P₄-M₁ of a "jaguar-like felid" from presumably Pleistocene deposits at Tequiquiac, Mexico. The specimen itself was lost before Freudenberg's study was published, but a photograph was preserved and reproduced by him. His remarks are not explicit, but seem to imply that he had handled the specimen before it was lost, although his measurements are given as from the photograph and so are subject to error. As Freudenberg said, the photograph shows a jaw completely jaguar-like, as far as it goes, except that the coronoid process is peculiarly hook-shaped. If this character is real, it is far more likely to be pathological or otherwise anomalous than to be a feature of taxonomic value.

If the measurements from the photograph are reliable, they indicate an M₁ about 24–25 mm. in length (Freudenberg says 25, the published photograph suggests a slightly smaller size), while P₄ is about 23¹/₂–24 mm. in length (24 according to Freudenberg). The length ratio P₄:M₁ was therefore probably between .94 and 1.00, with approximately .96 as the most

¹ I tentatively follow Wood (1929) in the nomenclature of these cusps.

likely figure. Not entirely distinctive, these ratios yet strongly suggest a jaguar or *P. atrox* in distinction from the pumas (see Fig. 5). The indicated size is smaller than specimens surely referred to *P. atrox* or its probable synonym *imperialis*, and compares closely with the large (male?) specimens of *P. onca augusta*, such as that from Craighead Caverns. It is at about the maximum for living jaguars belonging to *P. onca palustris* and is, as far as I know, larger than any living Mexican or Central American jaguars.

In the same deposit there was found an upper jaw with I³, C, and P³⁻⁴. This is at about the minimum size for *P. atrox* ("*P. imperialis*") from California. Freudenberg concluded that it belonged to an animal of about the same size as that just discussed. I think that it belonged to a slightly but distinctly larger animal. P⁴ of the animal represented by the mandible would be almost surely between 30 and 34 mm. in length, with 33 as the most probable figure. The Tequiquiac P⁴ measures 35 mm. As an isolated occurrence, this slight difference would not suggest any taxonomic distinction, but it happens that 35 mm. is just within the well-established range of the California *P. atrox* while 33 is not and is exactly right for typical *P. onca augusta*, as shown in Fig. 6. These facts tend to support the possibility that the Tequiquiac lower jaw is a large extinct true jaguar while the upper jaw is a female *P. atrox*. At the same time two other possibilities are not excluded by these unsatisfactory data: (1) that both Tequiquiac specimens belong to a small Mexican race of *P. atrox*, or (2) that both belong to a very large extinct Mexican race of *P. onca*. Except in size, there is no reliable difference between *P. onca* and *P. atrox* in the parts represented by these specimens.

"*Felis hyaenoides* Freudenberg, from the same deposit, is a sabertooth and not a feline.

One other specimen that requires comment is the fragmentary lower jaw from Port Kennedy, Pennsylvania, referred by Cope to *Felis inexpectata* (Cope, 1899, Pl. XXI, figs. 1a, 1b). This belonged to an animal considerably larger than the type

of *F. inexpectata* and the two could be of one race only on the assumption that the lower jaw is a male of maximum size and the type a female of minimum size, not impossible but improbable. Recently Gidley and Gazin (1938) have described what probably is a large individual of *F. inexpectata*, and its lower jaw and teeth are smaller than and different from Cope's referred specimen (see Fig. 3). They noted the disproportion of the Port Kennedy lower jaw and the possibility that it represents a different species.

The Port Kennedy lower jaw includes only M₁, the posterior part of P₄, and the ramus below these teeth and is not adequate for absolute determination in this difficult group. It does, however, differ from any known pumas and does not visibly differ from recent jaguars or the group of fossil jaguars described here, so that there is some probability that it belongs to the latter group.

These various occurrences of jaws and teeth thus demonstrate that jaguars formerly ranged widely over eastern United States. Although the specimens differ considerably in size and proportions, they do not differ more than do some individuals belonging to a single subspecies of recent jaguars and they do not serve to demonstrate that more than one group is represented, although of course this might prove to be true were more adequate series from the various localities at hand. No specific differences from *Panthera onca* are definitely shown, and the specimens must be referred to that species. On the basis of the present materials no distinction from *P. onca palustris* can be conclusively demonstrated. It is, however, manifestly improbable that this subspecies centering around the Chaco should have occurred in eastern United States. Moreover the few North American fossils are in several respects near the limits for the recent subspecies so that an adequate series might show a significant difference in average characters, although no such difference is yet shown. It therefore seems justified and is surely convenient to recognize this group tentatively as a distinct subspecies. "*Felis augustus*" is the oldest name applied

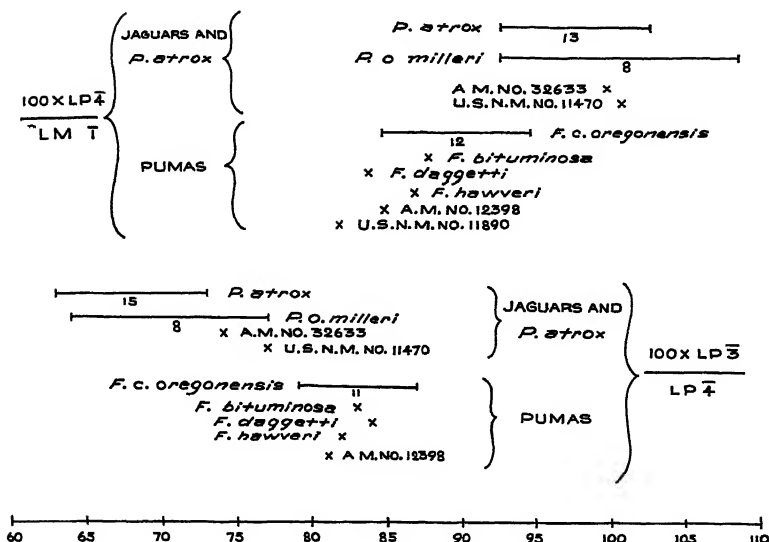


Fig. 5. Diagram of two dental indices in various large felines, as labeled. Crosses represent single specimens, lines samples of the size indicated by the number below the line. *P. atrox*, Rancho La Brea, data from Merriam and Stock. *P. o. milleri*, recent, Matto Grosso, specimens in American Museum. A.M. No. 32633, the Craighead Cat. U.S.N.M. No. 11470, Melbourne, Florida. *F. c. oregonensis*, living, western U. S., data from Merriam and Stock. *F. bituminosa*, type, data from Merriam and Stock. *F. daggetti*, type, data from Merriam and Stock. *F. hawveri*, type, data from Stock. A.M. No. 12398, Conard Fissure, Arkansas. U.S.N.M. No. 11890, Cumberland Cave, Maryland, data from Gidley and Gazin.

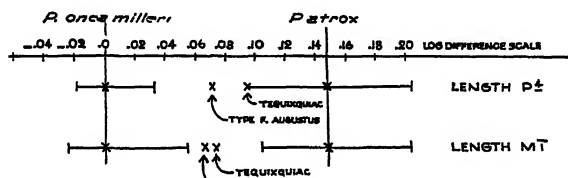


Fig. 6. Ratio diagram of lengths of P_4 and in various large felines, as labeled. Isolated crosses represent single specimens and lines represent larger samples with a cross at the mean value. *P. onca milleri*, Recent, Matto Grosso, specimens in American Museum. *P. atrox*, Rancho La Brea, data from Merriam and Stock. Tequiquiac, two specimens from that locality, in Mexico, data from Freudentberg. Craighead Caverns, the Craighead Cat.

to a probable member of this group, so that it may be provisionally designated as *Panthera onca augusta*.

The positive identification of *Panthera onca* adds another to the list of animals now mainly or typically South American but also typically North American in the Pleistocene. In view of the zoogeographic history of the two continents, it has long been assumed that the jaguar did migrate to South American from North America. It was therefore to be expected that it would

occur in the North American Pleistocene and the establishment of this as a fact is welcome confirmation of the theory.

It is also interesting that the most northern and northeastern race now known, this extinct *P. onca augusta*, so closely resembles the most southern and southeastern living race, *P. o. palustris*. As far as now known, the former ranged in latitude from about 20° (if the Mexican specimen belongs here) or 28° (Florida) to about 43° north, while the latter is known from about 20° to 38°

south (fossil only in the southern part)—remarkable concordance. The jaguars between these extremes are all smaller in size. A similar tendency for the extreme northern and southern races to be largest is seen among pumas. In South America jaguars are also known fossil in higher latitudes than in North America, nearly to 52° south, and the form there found, *P. onca mesembrina* Cabrera, 1934, is larger than the forms ranging through the thirties in either continent. Finally the ally known from the most extreme latitude, about 65° north, is *P. atrox*, largest of all. (Of course it also ranged into relatively low latitudes during the Glacial Epoch.)

The accompanying diagrams (Figs. 4-6) show some of the important relationships of size and proportion in the North American fossil jaguars here discussed, as well as in the fossil pumas to be mentioned in more detail on later pages. Perhaps the most interesting feature of the largely self-explanatory diagrams is their demonstration (Fig. 5) that the index $100 \times \text{length } P_3 / \text{length } P_4$, although it does not distinguish *P. atrox* from *P. onca*, does in most and perhaps in all cases distinguish these two from any of the fossil and living pumas. It is more distinctive than the index $100 \times \text{length } P_4 / \text{length } M_1$, which has previously

LOWER JAWS

	<i>P. onca augusta</i> (fossil)		<i>P. onca milleri</i> (recent)
	Amer. Mus. No. 32633 (male?)	U. S. Nat. Mus. No. 11470 (female?)	Observed range in eight specimens (including both males and females)
Length of ramus	203	ca. 173	162-206
Length of anterior border of symphysis	68	...	51-69
Depth below anterior end of P_4	42	ca. 34	33-40
Depth immediately posterior to M_1	43	37	35-41
Thickness posterior to M_1	17.5	16.0	13.5-18.5
C- M_1 , inclusive	105.4	95.0	87.1-102.1
P_3 - M_1 , inclusive	65.7	56.5	54.1-59.7
Canine alveolus { length	ca. 26	ca. 20	19-26
	ca. 23	ca. 18	16-21
P_3 { length	18.2	16.1	14.0-17.3
	width	8.3	7.4-9.5
P_4 { length	24.7	21.0	19.8-22.9
	width	ca. 11	9.8-12.8
M_1 { length	24.6	20.7	20.0-24.0
	width	11.1	10.2-13.0

UPPER JAWS

	<i>P. onca augusta</i> (fossil)	<i>P. onca milleri</i> (recent)
	Am. Mus. No. 32635 (male?)	Observed range in eight specimens (both male and female)
I^1 , maximum anteroposterior dimension of crown	6.9	5.9-6.9
I^2 , same	8.0	6.6-7.9
I^3 , same	11.0	8.8-11.2
Canine alveolus { length	21.8	20.1-26.2 (minimum for known males: 21.7)
	width	15.4-18.6 (minimum for known males: 16.4)
Diastema, C- P^3 , exclusive	13.7	10.0-17.5 (minimum for known males: 11.3)
P^2 { length	8.5	6.8-7.7
	width	5.2-5.8
P^3 { length	19.6	18.2-21.2
	width	9.1-11.4
Oblique distance, prosthion to lowest point on orbital rim ¹	102	85-110

¹ This odd and otherwise rather useless dimension is taken to give a rough idea of comparative gross size because it is one of the longest readily definable bone dimensions that can be taken on the fossil.

been used for this purpose and which does tend to distinguish jaguars and pumas but shows considerable overlap for values of the index from 93 to 95, inclusive.

The preceding measurements give a more

complete roster of the dimensions of the better specimens of North American fossil jaguars and a comparison of them with a series of recent jaguars of one subspecies (or lesser local race).

NORTH AMERICAN FOSSIL PUMAS

Unlike jaguars, it has long been recognized that pumas occur in the Pleistocene of North America. I do not now have any important undescribed specimens of this group and the purpose of the present section is to point out that certain species or supposed species not generally recognized as such are pumas and to suggest some possible relationships and identities within the group.

Teeth of approximately puma-size found in the Pleistocene of the eastern states have usually been referred to or compared with *Felis inexpectata*, founded by Cope on an imperfect P⁴ from Port Kennedy, Pennsylvania. In his definitive description (1899) Cope referred the species to *Uncia*, a genus used by him essentially as *Panthera* is in this paper and by most recent authors, but including the pumas as well as the lions, tigers, leopards, and jaguars. Cope then referred to "*Uncia inexpectata*" a lower jaw and various isolated teeth and skeletal parts. From his statements that *inexpectata* is a "large species of *Uncia*," the smaller skeletal parts "equal the average size of a jaguar," the species as a whole "as large as the jaguar," etc., he apparently based his final views more on these referred specimens than on the type, which is decidedly below average size for a jaguar and smaller than any but small females of the smallest races of jaguar, while it is of normal size for a robust puma. I have suggested above that his referred lower jaw probably does not belong to *F. inexpectata* and may well be a jaguar. This is probably true also of some of the referred skeletal parts, which I have not had occasion or opportunity to examine and restudy.

From the type alone it is almost impossible to determine the affinities of *F. inexpectata* beyond the fact that it is an advanced feline about as large as an average

male of one of the larger living races of pumas, e.g., *F. concolor hippolestes* or *oregonensis*. As far as I know, the only previously referred specimens permitting close determination of affinities are those described by Gidley and Gazin (1938) from Cumberland Cave, Maryland, including P⁴ and a lower jaw with P₁ and M₁. P⁴ is larger than the type of *F. inexpectata*, but the size is within the probable range even for a local race and the characters are otherwise closely similar. The lower jaw is, as Gidley and Gazin remarked, definitely puma-like and not jaguar-like, although slightly larger than most or any recent pumas. The relatively shallow jaw, the definition of the anterior end of the masseteric fossa and its position distinctly posterior to M₁, and, especially, the small size of P₄ relative to M₁ strongly suggest the pumas and practically exclude close relationship to the jaguars. These specimens are from near the type locality of *F. inexpectata* (about 175 miles) and occurred in similar geological circumstances. Subject to the reservations imposed by the fragmentary and scanty material, they strongly suggest that the name *F. inexpectata* belongs to a puma and that most of the specimens so identified are pumas.

Smilodontopsis mooreheadi Hay, 1920, was based on another isolated P⁴ found in the same region, at Cavetown, Maryland, under similar circumstances, and as far as such a specimen can be identified it appears to be the same as *F. inexpectata*.

It was apparently the belief that this tooth had no protocone that led Hay to consider it a sabertooth rather than a feline, with the additional evidence of the presence of a "preanterior lobe" (prostyle of Merriam and Stock). At the least, however, there is a protocone swelling and this and the (broken) third root were in the fe-

line position, quite different from the machairodontine. The preanterior lobe or prostyle is not a distinct cusp, as it almost always is in machairodontines, but only a slight rudiment such as is frequently present in felines. Moreover the protocone region shows distinct abrasion, probably post-mortem in origin, and it is possible and probable that a definite feline protocone was present before this occurred.¹ In short, this is a feline and not a machairodontine tooth.

Hay noted a resemblance to the type of *Felis inexpectata*, but said that the latter had a protocone and that on it the angle descending to the protocone from the outer cusp was stronger. The former distinction is now seen to be nonexistent or unreliable and the latter is slight and has no taxonomic value in allied recent forms. Hay's specimen is slightly larger, being 26.9 mm. in length (or 26.5, according to Hay), while Cope gives 24 mm. for his type, but this

kansas, with an isolated P_4^{**} and several skeletal parts referred. The latter will be mentioned on a later page. As regards the type tooth Brown noted the close resemblance to *F. inexpectata* and at first referred this material to that species, but he later erected a new species because P_4 is more massive, the protocone larger and farther forward, the tooth narrower, the "paracone" (parametacone of Wood) larger, the "metacone" (metastyle of Wood) projecting farther backward and at a more obtuse angle. As between the two type specimens, these distinctions are all real, but comparison of a series of recent pumas and of several fossils found since Brown made his study shows that none of them is outside the probable variation of a single species or perhaps subspecies. The local races could well be distinct, but the isolated specimens in hand do not and cannot prove this. The following measurements show some-

	" <i>F. longicrus</i> " type	<i>F. inexpectata</i> type. After Cope	" <i>Smilodontopsis</i> <i>mooreheadi</i> " type	U.S.N.M. No. 11890. After Gidley and Gazin	25 specimens of <i>F. concolor</i> <i>oregonensis</i>
Length P_4	27.3	24	26.9	26.6	20.2-25.3
Width P_4	13.4	(broken)	(abraded)	12.2	10.7-13.2

again is not sufficiently pronounced in itself to distinguish subspecies and still less species.

The synonymy is further supported by comparison with U.S. Nat. Mus. No. 11890, the P_4 from Cumberland Cave referred to *F. inexpectata* by Gidley and Gazin. This specimen is almost as large as the type of "*Smilodontopsis mooreheadi*," 26.5 mm. in length (26.6 according to Gidley and Gazin), and in general it is almost exactly like Hay's type except for the difference in preservation, not in original structure, of the protocone.

Felis longicrus Brown, 1908, is another supposed species not definitely distinguished from *F. inexpectata* by the known specimens and representing a species or subspecies of puma. It was based on an isolated P_4^{**} from the Conard Fissure, Ar-

thing of the normal range of variation in this and allied forms.

In the same publication Brown described a mandibular ramus that he referred questionably to *Felis cougar* (i.e., *Felis concolor cougar*). The specimen, Amer. Mus. No. 12398, was found with the type of *F. longicrus* (although clearly a different individual) and includes the canine and P_3 - M_1 . It certainly belongs to a puma of some sort and can be closely matched among modern pumas except that it is slightly larger than any individual with which I have compared it, without beings quite beyond the probable range for living forms. The small canine, high cheek-tooth crowns, shallow ramus, and particularly the length ratios of P_3 : P_4 and P_4 : M_1 are characteristically puma-like (see Fig. 5). M_1 in this jaw is 20.0 mm. in length. In twelve recent specimens of *F.*

¹ Drs. Gazin and Colbert also examined the specimen and agree with this statement.

* Misprinted M_1 in the original description.

** Misprinted P_3 and P_4 in different places in the original description.

concolor oregonensis, the index $100 \times LM_1:P^4$ varies from 73 to 85 and averages 78.4. P^4 of this individual would thus probably be about 25.5 mm. in length and may have been anything from 24 to 27 mm. Thus, even without allowing for the undoubtedly considerable individual variation, this lower jaw could belong to an individual of about the size either of the type of *F. longicrus* or that of *F. inexpectata*. It is certainly most improbable that two distinct puma-like felids of so nearly the same size occurred together in Arkansas, and it seems almost certain that this is the lower jaw of "*F. longicrus*."

This specimen compares very closely with the lower jaw referred by Gidley and Gazin to *F. inexpectata*, both in form and, as the following measurements show, in size:

		U.S. Nat. Mus. 11890.	
		Amer. Mus. No. 12398	After Gidley and Gazin
P_3	length	13.7	..
	width	7.0	..
P_4	length	17.1	17.2
	width	8.9	9.1
M_1	length	20.0	20.9
	width	9.2	9.6

These comparisons tend strongly to support the propositions (a) that *F. longicrus* and *F. inexpectata* are synonymous and (b) that all these forms are pumas.

If all these eastern specimens do belong to the same group, it was one that ranged and doubtless also averaged larger than do the living pumas, but one that intergraded with the latter in size and in all other known characters. Our knowledge is hardly yet adequate to demonstrate either the pres-

ence or the absence of specific distinction within the general fossil puma group. For convenience the specific name may be very tentatively retained, preferably in the form *Felis (Puma) inexpectata*, although the supposed species has not really been defined except for the very inadequate distinction that it probably attained a larger size than do recent specimens of *F. (P.) concolor*.

Various remains of fossil pumas, some of them relatively complete and excellently preserved, have been found near the Pacific coast. These have received three specific names, *Felis daggetti* Merriam, 1918, *Felis hawveri* Stock, 1918, and *Felis bituminosa* Merriam and Stock, 1932. I have not examined any original materials of these supposed species and can make no additions to the excellent descriptions given by Merriam and Stock, singly and together, and cannot make a revision of the somewhat less satisfactory taxonomy. It must be noted, however, that the published data do not compare *F. hawveri* and *F. bituminosa* and do not seem to demonstrate any valid taxonomic distinction between them, and that no comparison has been made with any of the eastern specimens of *F. longicrus*, *F. inexpectata*, etc., which, as far as they go are very similar to these western materials and could well represent races of the same species. It would also be advisable to consider the possibility that *F. bituminosa* (= *F. hawveri*?) is merely the female of *F. daggetti*, a possibility that seems to be rather supported than opposed by the published data. In any case, as Merriam and Stock have shown, these forms are true pumas and they may be referred to *Felis (Puma)*, either as distinct species or as subspecies of the closely allied recent *F. (P.) concolor*.

PANTHERA ATROX

This species has been so fully described and compared and beautifully illustrated by Merriam and Stock (1932) that no additions are possible or necessary. It is mentioned here in order to express the opinion, based mainly on their data and consistent with their views but not so definitely expressed by them, that it is distinctly closer to *P. onca* than to the lions and tigers of the Old World and that it could, indeed, be called an extinct giant jaguar.¹ Despite this affinity, Merriam and Stock have well shown the *P. atrox* is sharply distinct in size range and in some characters of shape and proportion from *P. onca* (see, for instance, Fig. 10), and I agree that it merits specific distinction. The clearest taxonomic expression of these views would

perhaps be to recognize the subgenus *Panthera* (*Jaguaris*) and to place *P. atrox* in it.

Although the type of *P. atrox* is from Natchez, Mississippi, the species has not otherwise been identified with certainty from anywhere east of the Rocky Mountains. A few limb bones and doubtful fragments suggest that it may have ranged in eastern United States, but it is in any case a rare fossil in this region. Similarly the large jaguars here called *P. onca augusta* have not yet been well identified from west of Nebraska, although some very dubious limb fragments suggest its possible presence in the farther west and it may have occurred in Mexico.

NOTES ON LIMB BONES

The preceding studies are based mainly on jaws and dentitions. The study of skeletal parts is more difficult and less conclusive because they are poorly known except in *P. atrox*, because they are sometimes less characteristic, and because adequate series of comparable recent specimens are difficult to obtain and have not been available to me. Nevertheless scattered skeletal remains afford some distributional data, or at least hints, that are of interest and a few of them warrant mention.

Gidley and Gazin (1938) referred to "*Felis* near *atrox*" scapholunar, second metacarpal, calcaneum, astragalus, and third and fifth metatarsals from Cumber-

land Cave. These elements are said to be too big to belong to a (recent) jaguar or puma, although smaller than any homologous *P. atrox* bones from Rancho La Brea. These various elements are not wholly diagnostic as to affinities with living pumas, jaguars, and *P. atrox*, especially as they evidently belong to some group distinct from any of these. They appear to me, on the whole, at least as puma-like as like the other two groups mentioned. The third metatarsal is stouter than in living pumas, and hence is jaguar-like in this respect, but all the bones otherwise agree fairly well with puma except in size. Their proportions, not only of the bones singly but also in comparison with each other, supposing all to represent a single species, are distinctive but are more like those of a puma than of a jaguar or *P. atrox*.

This is shown by the accompanying ratio-diagram, Fig. 7, the construction and interpretation of which are easy to accomplish but the principle of which is somewhat difficult to explain in words and is discussed in the last pages of this paper. An essential point is that if measurements of one individual, or means for a species, are set up in a vertical line, then series of homologous measurements of other indi-

¹ The habit of calling the machairodonts or saber-tooths "tigers" and *P. atrox* a "lion" in the vernacular is misleading, to the point of confusing scientific thought as well as misinforming the non-scientific, and it should be abandoned. To most Americans, both South and North American, the American "lion" is the puma and the American "tiger" is the jaguar. *P. atrox* is certainly nearer the American "tiger" than the American "lion." Many paleontologists and laymen tend to think of it as similar to the African lion, and the usual restorations are simply drawings of an African lion slightly modified in proportions. The known facts would equally well or better justify restoration as a jaguar of suitably modified proportions, which would produce a profoundly different picture and habit of thought about the animal. Of course the sabertooths were neither lions nor tigers, a fact so well known to paleontologists that calling them "tigers" is not confusing to the well-informed, although it certainly creates confusion among the non-scientific public.

viduals with similar proportions will also tend to fall into vertical lines, farther to the right or left in proportion as the animal is larger or smaller than that used as a standard of comparison. Here the Cumberland Cave specimens are treated as standard and their dimensions set in a single vertical line. Then the more nearly another set of measurements comes to vertical arrangement, the more nearly its proportions approximate those of the Cumberland Cave material. None of the three comparisons gives close approach to a vertical, but the recent puma comes much nearer than do the jaguar or *P. atrox*, and hence shows

semble the puma most and could well belong to a close ally of *F. concolor*, somewhat larger than the living members of the species. They are of about the right size to belong to *F. inexpectata* if, as is to be expected, that species was relatively small-headed, as is its ally *F. concolor*.

If these are skeletal elements of *F. inexpectata*, they tend to confirm the distinction of that species by showing that its feet may have had slightly different proportions than in *F. concolor*. The most definite suggestions are that the third metatarsal (at least) was relatively shorter and stouter in the extinct form and that

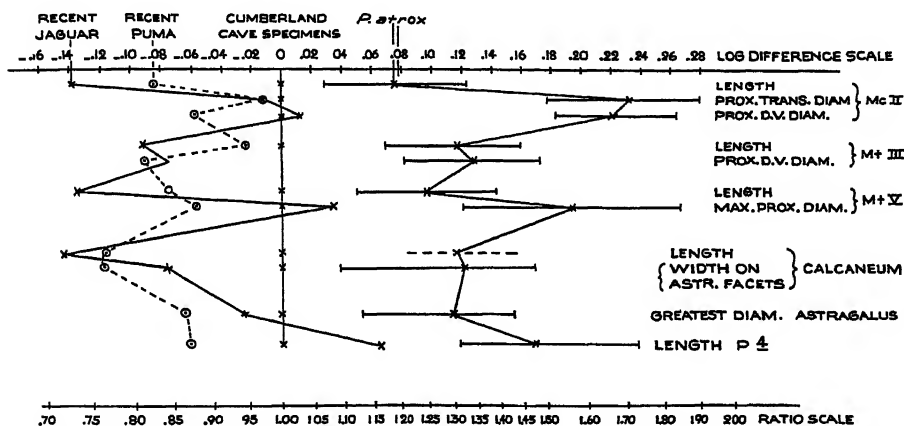


Fig. 7. Ratio diagram of dimensions of foot bones and P^4 in various large felines, as labeled. Recent jaguar and puma, from one individual of each, in American Museum. Cumberland Cave specimens, data from Gidley and Gazin. *P. atrox*, large samples from Rancho La Brea, data from Merriam and Stock; horizontal lines show observed range.

most nearly the proportions of the fossils. Closer approach would hardly be expected in view of the probability that the fossils are not all from one individual and are of a different species or subspecies from the living pumas. The diagram also shows that the fossils are closer to living jaguars and pumas than to *P. atrox* in size, and that they have about the same average proportions to a recent puma skeleton that the P^4 of *F. inexpectata* found in the same deposit has to P^4 of the same recent puma.

These bones do not belong to *P. atrox*, in which the range of variation is well established, and it is improbable that they belong to *P. onca*. On the whole they re-

semble the second metacarpal (at least) had a relatively narrower head.

In describing *F. longicrus*, Brown referred to it an ulna, complete except for the distal end, the distal end of a humerus, and various other isolated skeletal parts. The two principal specimens, figured by Brown on his Pl. xxiii, seem to me to be correctly referred and to represent *F. longicrus*, which I believe to be the same as *F. inexpectata*. They are very like *F. concolor* and hardly differ except in being larger and somewhat more elongate. They differ more markedly from the jaguar or *P. atrox*. In comparison with recent pumas as to proportions, they are appropriate in size

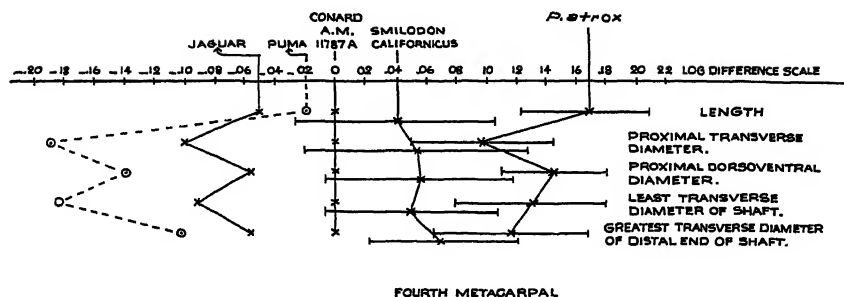


Fig. 8. Ratio diagram of dimensions of fourth metacarpal in various large felines, as labeled. Jaguar and puma, one specimen of each in American Museum. Conard, A.M. No. 11787A, one specimen from Conard Fissure, Arkansas. *Smilodon californicus* and *P. atrox*, large samples from Rancho La Brea, data from Merriam and Stock; horizontal lines show observed range.

for *F. inexpectata* (or *F. longicrus*), as Fig. 9B shows.

In the same collection, identified but not described by Brown as *F. longicrus*, there is a fourth metacarpal of considerable interest. Gidley and Gazin (1938, p. 53) mentioned it and noted resemblance to a saber-tooth.

The accompanying ratio diagram (Fig. 8) shows that the proportions are indeed more like *Smilodon* than like any of the large American true felines, notably in having the proximal and medial shaft transverse widths relatively greater than in the latter, including even the stout-footed jaguar and *P. atrox*. In fact, of the five standard dimensions all but the distal width are within the observed range of

Smilodon californicus (on Merriam and Stock's data). Aside from these characters of size and proportion, however, there are marked structural differences between the species here in question, and structurally the Conard Fissure bone is quite unlike *Smilodon*,¹ as shown by the following table of some of these characters (again drawing on Merriam and Stock for data on *Smilodon* and *P. atrox*).

In these structural features *P. atrox*, *P. onca*, and the Conard metacarpal IV are

¹ In view of some previous misunderstandings regarding metrical methods, it may be well to emphasize that these ratio diagrams do not directly or adequately in themselves determine affinities. They show only what is put into them: the comparative proportions of the parts measured. Similarity of proportions is one of the important data for determining relationships, but it is not the only nor a sufficient datum.

<i>Smilodon</i>	<i>P. atrox</i>	<i>P. onca</i>	Conard Fissure Specimen	<i>F. concolor</i>
External border of unciform facet curved	Straight	As in <i>P. atrox</i>	As in <i>P. atrox</i> and <i>P. onca</i>	Nearly straight
Notch on internal border of proximal end obscure	Sharp and pronounced	Strong but less sharp	As in <i>P. onca</i>	Rather obscure
No dorsal indentation between unciform and MC III facets	Deep, narrow indentation	Shallow, broad indentation	As in <i>P. onca</i>	Shallow, narrow indentation
Unciform and MC III facets continuous but at a sharp angle	Continuous, almost same plane	As in <i>P. atrox</i>	As in <i>P. atrox</i> and <i>P. onca</i>	Roughly parallel, but MC III facet sharply offset distally relative to unciform facet
Usually two distinct facets for MC V, not reaching proximal margin dorsally	Facets usually continuous, reaching proximal margin dorsally	More as in <i>P. atrox</i>	Nearly like <i>P. atrox</i> or <i>P. onca</i>	Nearly like <i>P. atrox</i> and <i>P. onca</i>
Palmar end of distal keel pronounced, ending abruptly	Less prominent, ending less abruptly	About as in <i>P. atrox</i>	More as in <i>Smilodon</i>	About intermediate in character

slight variants of the same type, while *Smilodon* on one hand and *F. concolor* on the other are markedly different. Relationship of the Conard specimen with either of the latter two is improbable. Even in its *Smilodon*-like proportions it is definitely more like *P. onca* than like *F. concolor*, and on the whole its general structure is nearer to *P. onca* than to the very similar *P. atrox*. It is also nearer to *P. onca* in size and is roughly of the right size for a robust male of *P. onca augusta* (see Fig. 9A). It

13. At the same time it is larger than any specimens now referred to *P. onca augusta*. The femur from Harvey Co. reported by Hibbard as *Felis* cf. *atrox* in the same paper has the same size relationships, being slightly smaller than Rancho La Brea *P. atrox* but larger than would be expected in *P. onca augusta* (in which this element is not known).

A fifth metacarpal from the same quarry as the "*Felis* cf. *imperialis*" tooth seems, as described and figured by Hibbard, to be

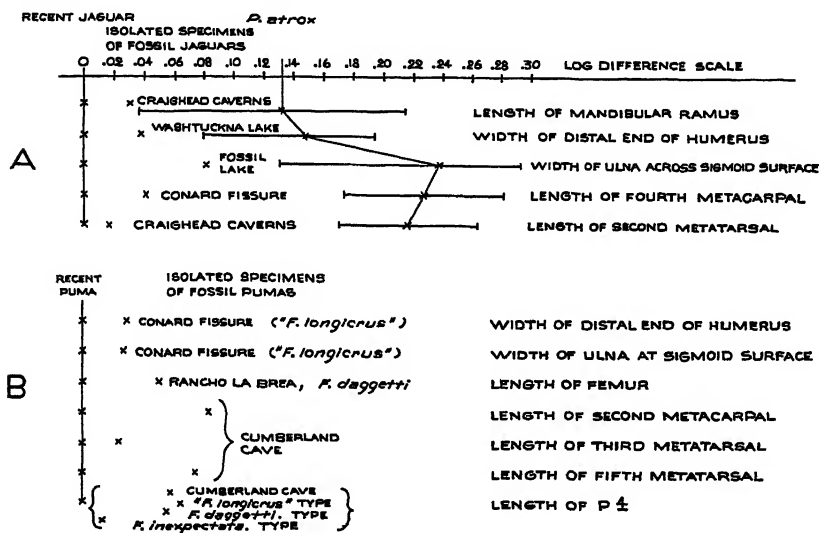


Fig. 9. Ratio diagrams of dimensions of various scattered large fossil feline remains, as labeled, compared with recent jaguar, A, and puma, B. Recent jaguar and puma, one specimen each in American Museum. *P. atrox*, sample from Rancho La Brea, after Merriam and Stock; horizontal lines show observed range. Isolated specimens from localities shown, further specified in text and in Figs. 4, 5, and 7.

may very well be a jaguar of this group, and it is very unlikely to belong to *F. longicrus* or *F. inexpectata*.

Hibbard (1939) has recently reported various feline remains from Meade County, Kansas. A left M_1 was classed as "*Felis* cf. *imperialis*" which according to Merriam and Stock (whose study apparently was not available to Hibbard) is indistinguishable from *P. atrox*. The tooth is said to measure 26 by 12.8 mm., hence is slightly smaller than the smallest Rancho La Brea specimens of *P. atrox*, for which Merriam and Stock give the minimum values 26.9 and

within the probable range of *P. atrox* and somewhat enhances the probability that all these remains do belong to that species. A broken M_1 evidently belonging to a puma of normal size was found at the same place.

As far as they are known to me, none of the many discoveries in California suggests the presence there of large felines other than *P. atrox* and various pumas, but isolated discoveries in Washington and Oregon hint that a big true jaguar, like *P. onca augusta*, may possibly have occurred there. In the "Washtuckna Lake" collection from Whitman County, Washington, there is an

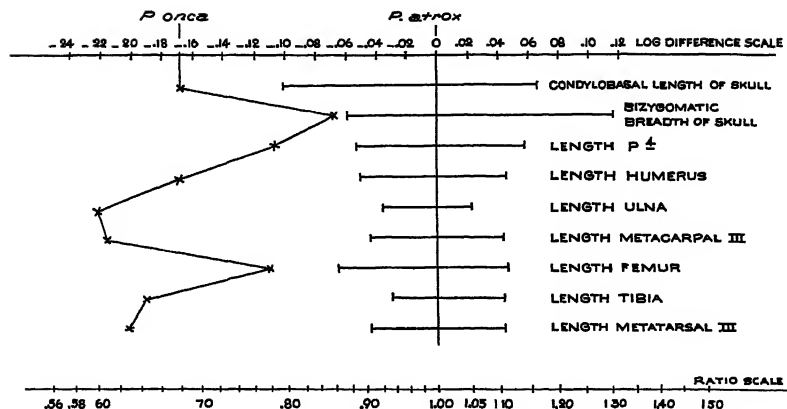


Fig. 10 Ratio diagram comparing various dimensions, as labeled, in a single recent jaguar and in the series of *P. atrox* described by Merriam and Stock.

imperfect distal end of a humerus, probably the basis for Matthew's report of "*Felis* cf. *imperialis*" (1902). It is very jaguar-like, as far as it goes, and on the basis of jaguar proportions belonged to an animal of about the size of the type of *P. onca augusta* (see Fig. 9A).

In redescribing the Fossil Lake, Oregon, material Elftman (1931) reported what he called "*Felis* sp. major" and "*Felis* sp. minor." The latter is smaller than the puma and so, although of great interest, is outside the scope of these notes. The former is known to me chiefly by Amer.

Mus. No. 8680, the proximal half of an ulna. Morphologically this differs noticeably from the puma but is almost exactly like a recent jaguar except for its greater size. The same is true of this part in *P. atrox*, which the fossil also resembles except for smaller size. These relationships suggest *P. onca augusta* and the ulna may belong to or be allied with that group, although on the basis of jaguar proportions it is somewhat larger than would be expected for an animal as large as any definitely identified as one of these great true jaguars (see Fig. 9A).

CONSPECTUS OF LARGE PLEISTOCENE FELINES OF NORTH AMERICA

The following list includes most or all of the occurrences that have been published. The numbers correspond with those of the accompanying map (Fig. 11). Each entry includes the locality, principal reference (often but not always the first published notice), name used in that publication, nature of the material, and the present identification or comments.

1.—Port Kennedy, Pa. Cope, 1899: *Uncia inexpectata*, type P⁴, referred jaw with P₄-M₁, various skeletal fragments. Type = *Felis* (*Puma*) *inexpectata*. Referred jaw perhaps *Panthera onca augusta*?

2.—Cavetown, Md. Hay, 1920: *Felis cougar*?, jaw fragment without teeth, and *Smilodontopsis mooreheadi*, type P⁴. Both specimens probably belong to *Felis* (*Puma*) *inexpectata*.

3.—Cumberland Cave, Md. Gidley and Gazin, 1938: *Felis* cf. *inexpectata*, P₄ and lower jaw with P₄-M₁, and *Felis* near *atrox*, isolated foot bones. The teeth almost surely and the foot bones possibly belong to *F. (P.) inexpectata*. The foot bones are not *P. atrox*.

4.—Craighead Caverns, Tenn. This paper: *Panthera onca augusta*, upper and lower jaws, etc.

5.—Vero, Fla. Hay, 1919: *F. veronis*, type P⁴. Probably a synonym of *P. onca augusta*.

6.—Melbourne, Fla. This paper: *P. onca augusta*, lower jaw and various isolated teeth.

7.—Seminole Field, Fla. Simpson, 1929: *Felis* cf. *veronis*, several isolated teeth, and *Felis* cf. *inexpectata*, isolated P⁴. Probably *P. onca augusta* and *F. (P.) inexpectata*.

8.—Sparta, Ill. Leidy, 1888: *Felis concolor*, cranium. Specimen not illustrated or restudied. Possibly recent?

9.—Natchez, Miss. Leidy, 1853; Merriam

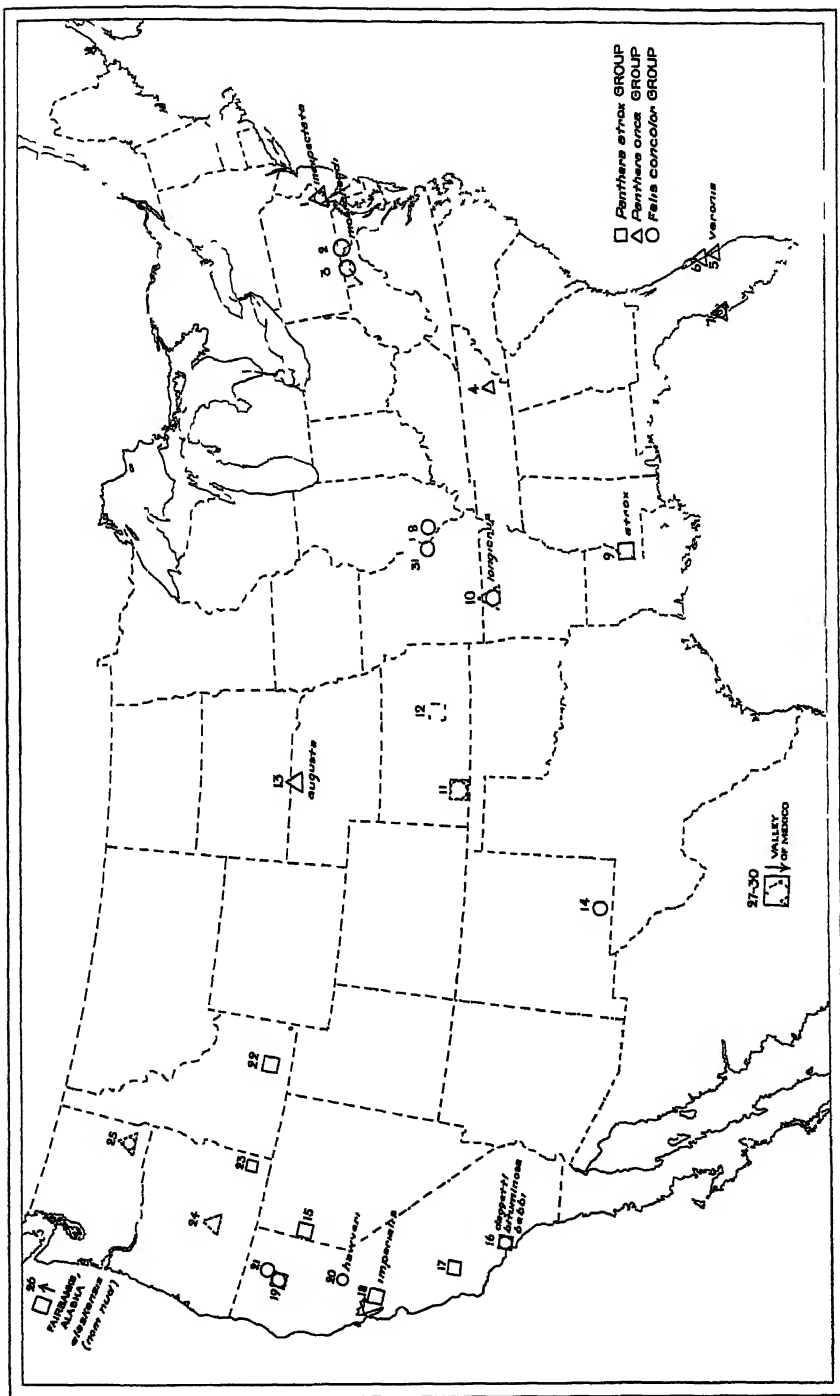


Fig. 11. Map showing places where large Pleistocene felines have been found in North America. The numbers correspond with the list given in the text. Trivial names of proposed species or subspecies are shown at their type localities. Symbols with broken outlines represent the more dubious identifications.

and Stock, 1932: *Felis atrox*, type, mandible with broken canine and P_2 - M_1 . *Panthera (Jaguaris) atrox*.

10.—Conard Fissure, Ark. Brown, 1908: *Felis longicrus*, type P_4 , referred P_4 and limb fragments, and *Felis cougar* (?), mandible with C - M_1 and end of humerus. Teeth and most limb material probably *Felis (Puma) inexpectata*. One or two limb bones may be *P. onca augusta*.

11.—Meade Co., Kansas. Hibbard, 1939: *Felis* cf. *imperialis*, M_1 and fifth metacarpal, and *Felis* cf. *oregonensis*, broken M_1 . The big cat may be *P. atrox*, although somewhat aberrant. The smaller is apparently a puma, but exact attribution uncertain.

12.—Harvey Co., Kansas. Hibbard, 1939. *Felis* cf. *atrox*, femur. Small for *P. atrox* but perhaps that species.

13.—Niobrara River, Neb. Leidy, 1873: *Felis augustus*, type, jaw fragment with P_4 , humerus fragment. *Panthera onca augusta*, Pleistocene, not Miocene as hitherto reported.

14.—Burnet Cave, N. M. Schultz and Howard: 1935. *Felis concolor hippolestes*, limb fragments. A large puma, but materials perhaps inadequate for subspecific identification. Possibly post-Pleistocene.

15.—Astor Pass, Nev. Merriam, 1915: *Felis atrox*, P_4 .

16.—Rancho La Brea, Calif. Merriam and Stock, 1932: *Felis atrox* (including *F. a. bebbi*, type, and *F. imperialis*), all parts of skull and skeleton, *F. daggetti*, type lower jaw, additional jaws and limb bones, *F. biuminosa*, type skull and jaws, additional skull, jaws, limb bones, *F. concolor*?, jaws. See discussion on previous pages.

17.—McKittrick, Calif. J. R. Schultz, 1938: *Felis atrox*, skulls, jaws, limb bones, *Felis daggetti*, skull.

18.—Livermore Valley, Calif. Leidy, 1873; Merriam and Stock, 1932: *Felis imperialis*, type upper jaw with P_3 . Female or small individual of *P. atrox*.

19.—Potter Creek Cave, Calif. Sinclair, 1904; Bovard, 1907; Merriam and Stock, 1932: *Felis* sp., *atrox* group, upper milk carnassial, *Felis* sp. near *daggetti*, jaws, *F. hippolestes*, skull, partial jaws. The situation regarding the pumas is not clear to me from the published data and a single variety of *F. concolor* or of *F. daggetti* (if that is valid) may be present.

20.—Hawver Cave, Calif. Stock, 1918; Merriam and Stock, 1932: *Felis hawveri*, type lower jaw with P_2 - M_1 , *Felis* sp. near *dag-*

getti, partial skull, jaws, foot bones. The published data do not fully establish the presence of more than one species of puma, see above.

21.—Samwell Cave, Calif. Furlong, 1906; Stock, 1918; Merriam and Stock, 1932: *Felis* sp., *hippolestes* or near *daggetti*, skull. The specimen does not appear to have been fully described or exactly identified.

22.—American Falls, Idaho. Gazin, 1935: *Felis* near *atrox*, metacarpal and radius. Somewhat small for *P. atrox*, affinities very uncertain.

23.—Malheur Co., Oregon. Merriam and Stock, 1932: *Felis* cf. *atrox*, fragment of lower jaw without teeth.

24.—Fossil Lake, Oregon. Elftman, 1931: *Felis* sp. major, skeletal fragments. In part suggestive of a large jaguar, or perhaps small *P. atrox*, but exact identification very uncertain.

25.—Whitman Co. (near Washtuckna Lake), Wash. Matthew, 1902: *F.* cf. *imperialis*, distal end of humerus, *Felis* cf. *concolor*, limb fragments. The large cat may be a true jaguar, cf. *P. onca augusta*, but identification uncertain.

26.—Fairbanks, Alaska. Friek, 1930: *Felis atrox alaskensis*, type. Not described.

27.—Tequiquiac, Mexico. Freudenberg, 1910: *Felis imperialis*, skull fragment with I^3 , C , P_2 - 4 , *Felis* cf. *imperialis*, mandible with P_2 - M_1 , *Felis atrox*, upper jaw fragment without teeth. The first and third specimens probably represent *Panthera atrox*, and the second is perhaps a jaguar, see above.¹

28.—San Luis, Mexico. Freudenberg, 1910: *Felis onca*?, broken canine. Very dubious, perhaps a jaguar.

29.—Mexico, exact locality unknown. Freudenberg, 1910: *F. concolor*, mandible. The identification is by Villada. Freudenberg had not seen the specimen and it has not been figured or described, nor are its age and geologic occurrence known. The record has no scientific value at present.

30.—Grand Canal, Valley of Mexico. Osborn, 1905: "large true cat, puma-like," skull. This specimen has not been described or figured and the identification and age are too uncertain to have positive value.

31.—Herculaneum, Missouri. Olson, 1940: *Felis* cf. *concolor*, upper carnassial.

¹ *Felis hyarnoides* Freudenberg, 1910, is usually cited as another large Pleistocene feline, but it is probably machairodontine and not feline. Freudenberg apparently later recognized this probability because in other lists (e.g., 1922) he referred the species to *Smilodonopsis*. It is based on an upper jaw fragment without teeth and is hardly identifiable in any case.

TAXONOMIC SUMMARY

The evidence reviewed on preceding pages suggests the following provisional taxonomic arrangement of the forms discussed in this paper.

FELIDAE

Felinae

GENUS PANTHERA

SUBGENUS JAGUARIUS

Panthera (Jaguaris) atrox (Leidy)

Felis atrox Leidy, 1853. Type, Phila. Acad. Nat. Sci. No. 12546, left lower jaw with broken C and P₂-M₁, from presumably Pleistocene deposit at Natchez, Mississippi.

Felis imperialis Leidy, 1873. Type, upper jaw with P₃, from presumably Pleistocene gravel at Livermore Valley, California.

Felis atrox var. *hebbi* Merriam, 1909. Type, Univ. Calif. No. 14001, skull, from Pleistocene asphalt pit at Rancho La Brea, California. Varietal or subspecific distinction from typical *P. atrox* not demonstrated.

Felis atrox alaskensis Frick, 1930. *Nomen nudum*.

Panthera (Jaguaris) onca augusta (Leidy)

Felis augustus Leidy, 1872. Type, U.S. Nat. Mus. No. 125, upper jaw fragment with left P₄ and broken P₃, from "Loup Fork" (Pleistocene not Miocene) of the Niobrara River, Nebraska.

Felis veronis Hay, 1919. Type, U.S. Nat. Mus. No. 11411, isolated left P₄, from Melbourne Formation, Pleistocene, at Vero, Florida.

Felis centralis? Gidley, in Hay, 1927, not *Felis centralis* Mearns, 1901.

GENUS FELIS

SUBGENUS PUMA

Felis (Puma) inexpectata (Cope)

Crocuta inexpectata Cope, 1895. Type, Phila. Acad. Nat. Sci. No. 52, isolated right P₄, from

Pleistocene fissure filling at Port Kennedy, Pennsylvania.

Uncia inexpectata Cope, 1899.

Felis longierus Brown, 1908. Type, Amer. Mus. No. 11787, isolated P₄, from Pleistocene fissure filling, Conard Fissure, Arkansas.

Felis cougar Brown, 1908, not *Felis cougar* Kerr, 1792.

Smilodontopsis mooreheadi Hay, 1920. Type, U.S. Nat. Mus. No. 9212, isolated right P₄, from Pleistocene fissure filling at Cavetown, Maryland.

This species is inadequately distinguished from *F. concolor*.

Felis (Puma) hawveri Stock

Felis hawveri Stock, 1918. Type, Univ. Calif. No. 10636, left lower jaw with P₂-M₁, from Pleistocene deposit in Hawver Cave, California.

This species is inadequately distinguished from *F. inexpectata*.

Felis (Puma) daggetti Merriam

Felis daggetti Merriam, 1918. Type, Univ. Calif. No. 21572, left lower jaw with C and P₂-M₁, from Pleistocene asphalt pit at Rancho La Brea, California.

This species is inadequately distinguished from *F. inexpectata* and may possibly be based on a robust male of the species to which the type of *F. hawveri* belongs.

Felis (Puma) bituminosa

Merriam and Stock

Felis bituminosa Merriam and Stock, 1932. Type, Los Angeles Mus. No. X8628, essentially complete skull and jaws, from Pleistocene asphalt pit at Rancho La Brea, California.

This species is inadequately distinguished from *F. inexpectata* or *F. hawveri* and may possibly be based on a female of *F. daggetti*.

EXPLANATION OF RATIO DIAGRAMS

Figs. 3 and 6-10 of this paper are constructed on a principle that I have not seen used elsewhere and they require some explanation. The method is one that lends itself readily to several useful types of graphic analysis and comparison and may therefore find wide application. I have found it convenient as an aid in distinguishing species and determining affinities, in sorting collections of bones, and in various ways beyond those illustrated in this publication.

The basic purpose of the diagram is to repre-

sent each of a number of analogous observations by a single entry and to plot them in such a way that the horizontal distance between any two of them will represent the ratio of either one of those two to the other. A simple plotting of calculated ratios, as in Fig. 5, has various and valuable properties, but it does not have the basic property sought for these more generalized ratio diagrams. It shows the ratios of various observations to one fixed standard or between fixed single items in one series to similar single

items paired with these in a related series, but it cannot show ratios between any two observations among many.

Consideration of the desired properties shows that the scale used must be logarithmic and not arithmetic. For instance, given absolute values $a=1$, $b=2$, and $c=4$, the distance plotted between a and b should be the same as between b and c , because $a:b=b:c$. This is true on logarithmic but not on arithmetic coordinates. Since it is desired to ignore absolute values and represent only ratios, the simplest approach is to plot the logarithms of ratios. The logarithm of a ratio is the difference between the logarithms of the two absolute measurements entering into the ratio. The easiest method, then, is to plot the differences between logarithms. By using these differences as they are, not converting them to antilogs, a step may be saved and also ordinary arithmetic graph paper may be used, since plotting logs on this gives the same result as plotting antilogs on logarithmic paper.

For calculation, the direct measurements are first converted to their logarithms, three decimal places generally sufficing. Some one observation is then taken as "standard," to represent zero difference in logarithms which corresponds with the ratio 1.00. Observations larger than this then fall to the right of it at distances determined by their ratios to it, and smaller observations similarly fall to the left. Although the differences are thus calculated from some one standard, the resulting diagram shows not only ratios to that standard but also ratios of any combinations of observations: once the diagram is made, the zero point, or ratio 1.00 point, may be placed anywhere and ratios of all other observations to that point will still be correctly represented.

The arithmetic involved is much simpler than calculating even one set of ratios, not to speak of all possible sets, in spite of the fact that the resulting diagram does represent all possible sets. For instance, all the arithmetical calculation for the top line of Fig. 7 is as follows:

A scale for reading ratios directly from the diagram can easily be constructed and one correct for the ratio figures in this paper is printed at the bottom of Figs. 7 and 10. By copying this on a separate slip of paper, a movable scale can be made and the diagrams have the property that if 1.00 on the ratio scale be set at any specimen (whether the standard or not), the values of the ratios of all other specimens (set on the same horizontal) to this one can at once be read on the scale.

All the ratio diagrams are here reproduced on the same scale, so that a scale traced from Figs. 7 and 10 is valid for all. In study it is convenient to adhere to a single scale as far as possible. On study sheets, using arithmetic graph paper ruled in millimeters, I have found scaling log difference .02 as 10 millimeters to be most convenient.

Points marked on a single horizontal line represent different values of one variate. In the diagrams in this paper they represent homologous dimensions of different specimens, but any series of values of one variate can be used. The further and perhaps greatest usefulness of the method lies in the arrangement and interpretation of diagrams in which several different variates are involved, each represented by one horizontal series and these series arranged one below the other. The horizontal single variate series are so placed that related points fall into a single vertical line. For instance, different measurements on one individual may be placed in a vertical line, as in Fig. 9, or mean values for a unified sample may be so placed, as in Fig. 10, or values for a group of specimens may be thus arranged in order to test the hypothesis that they represent one species and to see what comparable species they most nearly resemble in their ratios to each other, as in Fig. 7.

The diagrams so constructed have many different uses and properties, some of which will be mentioned and others of which will be seen as the method is used.

If a series of measurements involves the same

VARIATE: length of second metacarpal

Specimen	Measurement in mm.	Log	Difference from log of standard of comparison
U.S.N.M. No. 12840	94	1.973	0 (This is the standard here used)
Recent jaguar	68.3	1.834	-.139
Recent puma	77.2	1.888	-.085
<i>P. atrox</i> from	124.4	2.095	+.122
Rancho La Brea { maximum	...	2.048	+.075
{ app. mean ¹	100.4	2.002	+.029
{ minimum			

These figures can then be plotted against the log difference scale as shown.

¹ Data are from Merriam and Stock who do not give the mean or the figures from which it could be calculated. The range mid-point of the logarithms is taken as a sufficiently close approximation to the logarithm of the mean.

ratios as the standard of comparison, or, dealing with two individual animals, if a second animal has the same proportions throughout the parts measured as has the animal with which it is being compared, then this series being compared will also fall into a straight vertical line, regard-

less of whether the two animals are of the same absolute size or not. The more nearly the comparative series approaches the proportions of the standard series, the nearer will the comparative series come to falling into a vertical line. Thus in Fig. 7 the series representing the puma, although not in a vertical line, is obviously nearer to being in such a line than are those for the jaguar and for *P. atrox*. It therefore follows that the recent puma is, of these three, nearest to the proportions shown by the Cumberland Cave specimens.

If, as is generally the case, it can be postulated that scattered and isolated specimens belonged to animals with about the same proportions as some available standard of comparison, then the method makes it possible to compare the sizes of two or more animals known only by different specimens that are not homologous and that cannot be directed compared. Thus in Fig. 9 it is a permissible postulate that the fossil jaguars had approximately the proportions of a recent jaguar. The mandible and the metatarsal from Craighead Caverns, the humerus fragment from Washtuckna Lake, and the metacarpal from Conard Fissure fall in the diagram near a single vertical line. They therefore are shown to have belonged to animals of almost the same size. The ulna from Fossil Lake belonged, on this postulate, to a larger animal, but the probable amount of variation (as shown, for instance, by the comparable series for *P. atrox*) is such that it still is of a size probable for members of the same species.

A related use of the method is to estimate the relative sizes of missing parts of specimens, a procedure illustrated in Fig. 6. In this diagram the vertical alignment is on the means for *P. onca milleri*. The fact that the means for *P. atrox* also are almost precisely on a vertical line shows that in that species the average ratio of length P_4 to length M_1 was the same as in *P. onca milleri*. By plotting other specimens either of P_4 or of M_1 , the most probable relative size of missing carnassials of the same animals is shown by a position on a vertical line through the point indicating a known carnassial. Thus P_4 is unknown in the Craighead Caverns cat, but erecting a vertical from the point represent-

ing its M_1 to the horizontal line on which P_4 is graphed shows that P_4 in this individual must have been smaller than in *P. atrox*, larger than in *P. onca milleri*, and almost exactly the size of the type of "*F. augustus*."

Similarly the unknown P_4 of the individual represented by the lower jaw from Tequiquiac (Freudenberg, 1910) was smaller than the P_4 known from the same locality and was almost exactly the size of the type of "*F. augustus*." Or, working in the opposite direction, the diagram shows that the missing M_1 of the type specimen of "*F. augustus*" was larger than in *P. onca milleri*, smaller than in *P. atrox*, and almost exactly as long as the lower carnassials known from Craighead Caverns and from Tequiquiac.

Finally when the sets of measurements used represent individuals or species that do, in fact, have different proportions, such diagrams show in a simple and immediately apparent way what these differences are. Thus Fig. 10 compares means and observed ranges for some of the most important dimensions in *P. atrox* with the same dimensions in one specimen of recent *P. onca*. The comparison would, of course, have been more reliable if averages for a series of *P. onca* were used, but for the limbs no such series is available to me and the individual comparison suffices for present purposes. From this diagram it is at once obvious that the recent jaguar has the skull broader relative to its length than in *P. atrox*, the distal limb segments shorter relative to humerus and femur, hind-limb longer relative to fore-limb but metatarsals about the same relative to metacarpals, carnassial about the same relative to gross size of skull, being larger relative to skull length and shorter relative to skull breadth, and so on. The proportions of any two of these variates in *P. onca* as compared with *P. atrox* can be directly observed in the chart without further work. To make similar comparison by non-graphic means would involve the arithmetic determination, for this example, of at least 108 different ratios, and when this labor was completed the results still would not be as clear and usable as they are in this one simple diagram.

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THE CARIDEA AND STOMATOPODA OF THE SECOND TEMPLETON CROCKER-AMERICAN MUSEUM EXPEDITION TO THE PACIFIC OCEAN

By JOHN C. ARMSTRONG

The itinerary and personnel of the expedition, which was made possible through the generosity of Mr. Templeton Crocker, who accompanied it, and led by Dr. Roy W. Miner of the Department of Living invertebrates of The American Museum of Natural History, have been fully described by Melbourne Ward in the report of the Brachyura.¹ The work was undertaken on board Mr. Crocker's yacht, "Zaca," during the winter of 1936.

The collection of Caridea and Stomatopoda comprises thirty-one species of carids and four of stomatopods. Of these, two species of Caridea, *Crangon crockeri* and *Lysemata zaca*, have been described as new.

With the exception of *Gnathophyllum panamense* previously known only from Panama and of the new species, all the Caridea taken are known from the Indo-Pacific region, some of them having been reported as far west as the Red Sea or the Seychelles Islands. The four species of stomatopods are all known to have wide ranges in the Indo-Pacific region. In fact, so widespread is this fauna that, while the Crocker collections constitute a very valuable addition to our scanty knowledge of the distribution of Pacific Caridea and Stomatopoda, it does not seem advisable to enter into any detailed comparisons with other faunas at this time.

CARIDEA

Leptochela robusta Stimpson

Leptochela robusta STIMPSON, W., 1860, Proc. Phil. Acad. Nat. Sci., p. 43.—DE MAN, J. G., 1920, "Siboga" Exped. Monogr. XXXIX a3, p. 19.—KEMP, S., 1925, Rec. Ind. Mus., XXVII, p. 252.

¹ 1939, A.M.N.H. Novitates, No. 1049, pp. 1-15, Figs. 1-17.

SPECIMENS COLLECTED.—14 males, 2 females, 1 immature taken at submerged light, Apia Harbor, Upolu Island, Samoa, Oct. 12.

REMARKS.—These specimens differ slightly from de Man's figures in that the second (middle) pair of dorsal spines on the telson are much smaller than those of the other two pairs and are placed a little nearer the lateral margin of the telson than are the third. Both the females lack the dorsal carinae on the carapace indicating, according to Kemp (1925, p. 250), that they have not born eggs at least since the last molt.

The sex ratio of both this species and the following is unusual among the Caridea, many carids having a far greater number of females than males. It is suggestive that collections of *L. robusta* made with nets in other localities have shown the type of sex ratio usual among the carids. The hypothesis is, therefore, tentatively advanced that the anomalous sex ratio of the present collection may be due to the fact it was made at a submerged light which may exert a greater attraction upon the males than the females.

Leptochela aculeocaudata hainanensis Yü

Leptochela hainanensis YÜ, S. C., 1936, Chin. Jour. Zool., II, p. 87, Figs. 1-3.

SPECIMENS COLLECTED.—3 females and 26 males taken at submerged light, Apia Harbor, Upolu Island, Samoa, Oct. 12.

REMARKS.—The specimens taken at Samoa differ from the extensive descriptions of *aculeocaudata* given by Kemp^{2,3} in the length of the rostrum and the

² 1915, Mem. Ind. Mus., V, 310-316.

³ 1925, Rec. Ind. Mus., XXVII, pp. 254-255.

proportions of certain appendages. While these differences, summarized in tabular form below, appear to be sufficient to distinguish the populations involved, it is not believed that they warrant a specific separation. The material shows a considerable range of variation in all the distinguishing characters, most of these tending to merge at the extremities of variation. Indeed, if we are willing to ascribe to *aculeocaudata* even a somewhat lesser degree of variability, then all these characters will so merge. That we are not dealing with a mixed population of two species seems to be indicated by the continuous nature of the variation in most of these features and by the fact that in the present material these may vary independently; individuals which resemble the typical form in one character may be far removed in another. As most of the specimens can be readily separated from the typical form as defined by Kemp, I believe that it had best be treated as a subspecies for the present.

The question of its identity with Yü's *hainanensis* remains. The characters given by Yü¹ as distinguishing *hainanensis* from *aculeocaudata* are: (1) The antennal scale is broader; 3 times as long as wide rather than 4 times. The outer margin is nearly straight, not concave behind the middle. (2) The exopod of the fifth pair of pereopods is shorter reaching only a little beyond the distal end of the basis rather than "reaching not much beyond the middle of the ischium."² (3) Of the five pairs of spines at the apex of the telson the outer (first) pair extend only to the middle of the third pair and the second pair reach at least two-thirds of the length of the fourth, while in *aculeocaudata* the first pair extend almost to the end of the third pair and the second pair reach only to the middle of the fourth pair.

Only in the first of these do we find any point of difference with our Samoa specimens. Only one of our specimens had an antennal scale that measured fully 3

times as long as wide; the mean was about 3.5. The outer margin of most of the scales, while somewhat straighter than Kemp's figure of *aculeocaudata*, had more of a concavity than in Yü's figure. The exopod of the fifth leg does appear to be shorter in most specimens than indicated by Kemp but this feature does not lend itself to an accurate comparison with the published data as the obliquity of the baso-ischium articulation is such that the exopod may appear to be near the middle of the ischium when seen from one angle and scarcely to exceed the articulation when viewed from another. There appears also to be some variation in the length of that appendage. As may be seen from Table IX, the length of the apical telson spines is in agreement with Yü's description.

In the absence of any more critically diagnostic feature than the somewhat tenuous difference in the proportions of the antennal scale, I have provisionally placed the Samoa form under Yü's name until a more exhaustive study can be made of the range of variations in the forms involved.

While the tricarination of the carapace of the males of the Samoa material is a very curious feature not having been previously reported in any species of *Leptochela* thus far described, the presence or absence of these carinae in the females is known to be related to the sexual condition of the individuals and I do not believe that any systematic reliance can be placed on this character until it is known whether their appearance on the males may not also be dependent on some such condition.

As many of the characters which separate *hainanensis* from *aculeocaudata* tend to approach the condition in *pugnax*, the tabular view of their characters has included the latter species. The characters of *aculeocaudata* have been taken from Kemp;^{3,4} those of *pugnax* from Kemp⁴ and de Man.⁵

¹ 1915, Mem. Ind. Mus., V, pp. 310-316.

² 1925, Rec. Ind. Mus., XXVII, pp. 254-255.

³ 1920, "Siboga" Exped. Mongr. XXXIX a3, pp. 26-30, Pl. iv, figs. 8-8d.

⁴ 1936, Chin. Jour. Zool., II, p. 87, Figs. 1-3.

⁵ 1925, Rec. Ind. Mus., XXVII, pp. 254-255.

aculeocaudata, s. s.

- 1.—The rostrum extends to the middle of the cornea or to the end of the eye and does not reach the end of the basal antennular segment
- 2.—Carapace tricarinate in ovigerous or recently ovigerous females only
- 3.—The antennal spine is absent and the orbital margin is not serrated
- 4.—The antennal scale is about 4 times as long as wide
- 5.—The antennular peduncle reaches a little beyond the middle of the antennal scale
- 6.—The penultimate segment of the third maxilliped is from 1.25 to 1.28 times the length of the ultimate segment
- 7.—In the second leg the fingers are usually decidedly less than twice as long as the palm, about 1.75 times, very rarely just twice as long. There are from 18–25 spines on the inner margin of the dactylus and from 21 to 28 on the fixed finger
- 8.—There are from 10 to 15 spines on the external margin of the outer uropod and from 3 to 5 on the upper surface of the inner uropod near the apex
- 9.—Of the five pairs of spines of the apex of the telson the outer (first) pair extend almost to the end of the third pair. The second pair reach to the middle of the fourth pair

aculeocaudata hainanensis

The rostrum reaches to or beyond the end of the eye and sometimes to the middle of the second antennular segment (Table I)

Carapace tricarinate in both males and females

Same as the typical form

The antennal scale is from 3 to 4 times as long as wide, usually about 3.5 (Table II)

The antennular peduncle reaches distinctly beyond the middle, usually about to the distal third of the antennal scale (Table III)

The penultimate segment of the third maxilliped is from 1.3–1.4 times the length of the ultimate segment (Table IV)

In the second leg the fingers are from 2.0 to 2.4 times, usually about 2.2 to 2.3 times, as long as the palm. There are from 17 to 26 spines on the inner margin of the dactylus and from 18 to 30 on the fixed finger (Tables V and VI)

There are from 10 to 14 spines on the external margin of the outer uropod and from 3 to 5 on the upper surface of the inner uropod near the apex (Tables VII and VIII)

Of the five pairs of spines at the apex of the telson, the outer pair fall well short of the end of the third pair. The second pair reach beyond the middle (usually about to the distal third) of the fourth pair (Table IX)

pugnax

The rostrum reaches to or beyond the end of the eye often extending to the distal end of the basal antennular segment

Same as *aculeocaudata*

The antennal spine is present; the orbital margin is not serrated

The antennal scale is about 4 times as long as wide

The antennular peduncle reaches to the distal third of the antennal scale

The penultimate segment of the third maxilliped is about 1.4 times as long as the ultimate segment

In the second leg the fingers are from 2.0 to 2.25 times as long as the palm. There are from 17 to 23 spines on the inner margin of the dactylus and from 19 to 28 on the fixed finger

There are from 9 to 11 spines on the external margin of the outer uropod and 3 or 4 on the upper surface of the inner

Of the five pairs of spines at the apex of the telson, the outer pair extend about one-third the length of the third pair. The second pair reach a little beyond the middle of the fourth pair¹

¹ Proportions deduced from de Man's figure (1920, *op. cit.*, XXXIX a3).

Variations in *Leptochela aculeocaudata hainanensis*

TABLE I

Length of Rostrum	No. of Specimens
LENGTH OF ROSTRUM	
Reaching to middle of second antennular segment	1
Slightly exceeding the end of first antennular segment	4
Reaching to end of first antennular segment	6
Reaching to end of eyes but falling a little short of the end of first antennular segment	8
Falling just short of the end of the eyes but in advance of the middle of the cornea	

TABLE II

Ratio of the Length of the Antennal Scale to Its Greatest Width

LENGTH/WIDTH	No. of Specimens
3.0	1
3.1	0
3.2	0
3.3	1
3.4	2
3.5	7
3.6	3
3.7	1
3.8	2
3.9	0
4.0	2

TABLE III

Distance along the Antennal Scale to Which the Antennular Peduncle Extends Expressed as the Ratio of That Distance to the Length of the Antennal Scale

ANTENNULAR PEDUNCLE/SCALE	No. of Specimens
0.63	1
0.69	1
0.71	1
0.74	1
0.77	3
0.78	2
0.79	4
0.80	2
0.81	1
0.82	1
0.83	1

TABLE IV

Ratio of the Length of the Penultimate to the Length of the Ultimate Segment of the Third Maxilliped

PENULTIMATE/ULTIMATE	NUMBER OF MAXILLIPEDS
1.30-1.34	27
1.35-1.40	13

TABLE V

Number of Spines on the Fingers of the Second Chela

NUMBER OF SPINES	NUMBER OF FIXED FINGERS	NUMBER OF MOVABLE FINGERS
17	0	1
18	1	0
19	0	0
20	0	2
21	0	0
22	0	2
23	1	2
24	2	3
25	2	2
26	5	2
27	0	0
28	2	0
29	2	0
30	1	0

TABLE VI

Ratio of the Length of the Fingers to the Length of the Palm of the Second Chela

FINGERS/PALM	NUMBER OF CHELAE
2.0	4
2.1	5
2.2	13
2.3	18
2.4	5

TABLE VII

Number of Spines on the External Margin of the Outer Uropods

NUMBER OF SPINES	NUMBER OF UROPODS
10	4
11	16
12	23
13	7
14	2

TABLE VIII

Number of Spines on the External Margin of the Inner Uropods

NUMBER OF SPINES	NUMBER OF UROPODS
3	5
4	35
5	9
6	2

TABLE IX

Relative Lengths of the Apical Spines on the Telson

Distance the first pair extends along the third pair. (Expressed as a fraction of the length of the third pair)		Distance the second pair extends along the fourth pair. (Expressed as a fraction of the length of the fourth pair)	
NUMBER OF TELSONS	LENGTH OF EXTENSION	NUMBER OF TELSONS	LENGTH OF EXTENSION
1	0.42	1	0.53
1	0.44	1	0.55
1	0.48	1	0.56
7	0.50	1	0.57
4	0.53	2	0.58
2	0.54	1	0.59
1	0.55	5	0.60
2	0.56	1	0.61
1	0.59	5	0.63
2	0.60	4	0.64
1	0.64	1	0.65
1	0.65	1	0.70
2	0.67	1	0.71

Thalassocaris crinita (Dana)

Regulus crinitus, DANA, J. D., 1852, U. S. Explor. Exped. Crust., I, p. 599, Pl. XXXIX, fig. 6a-h.

Thalassocaris crinitus, BALSS, H., 1914, Abh. Math.-Phys. Kl. K. Bayer. Akad. Wiss., Suppl. Bd. II, Abh. 10, p. 28.

T. crinita, DE MAN, J. G., 1920, "Siboga" Exped. Mongr., XXXIX a3, p. 95, Pl. IX, figs. 22-22c.—KEMP, S., 1925, Rec. Ind. Mus., XXVII, p. 284.

SPECIMENS COLLECTED.—2 males, taken in hand net at surface next to pier, Pago Pago Harbor, Samoa, Oct. 6. 1 female, taken at submerged light in lagoon, Omoko anchorage, Penrhyn Island, Sept. 18.

REMARKS.—One of the males has only two teeth on the outer margin of the scaphocerite instead of the three mentioned by de Man and present on the other two specimens.

Athanas djiboutensis Coutière

Athanas djiboutensis COUTIÈRE, H., 1897, Bull. Paris Mus., VI, p. 233.

A. sulcatipes BORRADAILE, L. A., 1898, Proc. Zool. Soc. London, p. 1011, Pl. LXV, fig. 9.

SPECIMENS COLLECTED.—1 ovigerous female from broken up masses of coral, depth 2.3 feet, west of anchorage, Mataatu Harbor, Savaii, Oct. 11.

Alpheopsis aequalis Coutière

Figure 1

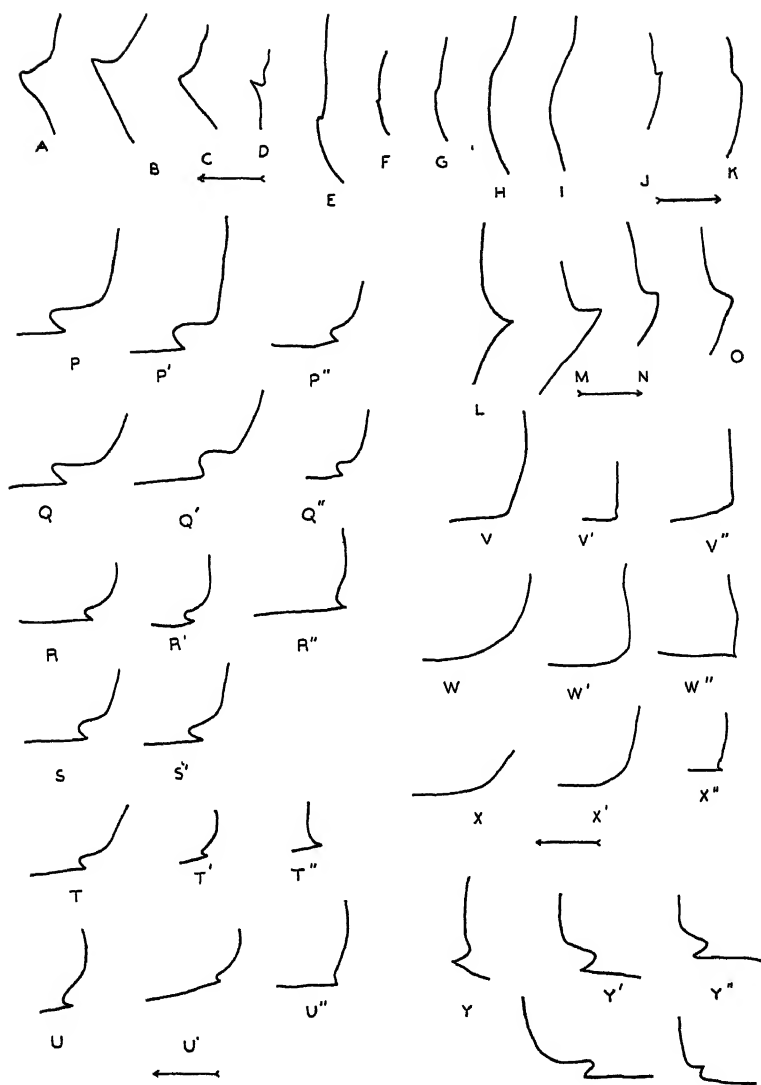
Alpheopsis aequalis COUTIÈRE, H., 1896, Bull. Mus. Paris, II, p. 382; 1899, Ann. Sci. Nat. Zool., (8) IX, p. 496; 1905, Fauna and Geog. Mald. and Lacc. Arch., II, pt. I, Report 6, p. 869, Fig. 138; 1906, Bull. Mus. Paris, XII, p. 377.—DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 177.

A. consobrinus DE MAN, 1910, Tijdschr. d. Ned. Dierk. Vereen., (2) XI, p. 305; 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 178, Pl. v, fig. 16.

SPECIMENS COLLECTED.—4 females (1 ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 1 female, 1 male from broken up masses of coral, depth 8 feet, same locality, Oct. 17. 1 ovigerous female, 1 male from broken up masses of coral, depth 6 feet, same locality, Oct. 18.

REMARKS.—In addition to the specimens listed above, 5 other females in the collections of The American Museum of Natural History have been examined. The series of specimens thus available shows a greater range of variation than had previously been suspected to exist in the species and has led me to include in it both de Man's *A. consobrinus* and some West Indian examples which at first sight appeared to be distinct.

A. aequalis was described by Coutière in 1896 in a very brief diagnosis of two lines, without a figure, based upon two specimens from the Red Sea and two from the Indian Ocean. Later in 1899 he added the information that the color of the living animal was "... d'une color orangée uniforme, légèrement plus foncées à l'extrémité des pinces; ..." and in 1905, by way of comparison with a new variety (*A. a. var. truncatus*), gave figures of both the dorsal and lateral views of the frontal structures of the type. In 1906 he published a key to the species of the genus without, however, adding anything to the known characters of the *A. aequalis*. Among the alpheopsids collected by the "Siboga," de Man found a single specimen of a species whose possession of a pterygostomial spine led him to consider it as distinct from *aequalis*. As will be seen below, this form, so described and figured by de Man, is most probably identical with Coutière's.

Fig. 1. *Alpheopsis aequalis* Coutière

(Arrows point toward the head of the animal)

A-I, pterygostomial angle of the left side of specimens A, D, C, K, B, E, G, H and F; J-O, pterygostomial angle of the right side of specimens M, E, D, B and C; P, P', P''-X, X', X'', posterior borders of the left third, fourth and fifth pleura of specimens F, D, H, A, G, I, C, M and K; Y, Y', Y'', and Z, Z', posterior borders of the right third, fourth and fifth pleura of specimen E and of the right and fourth pleura of specimen I.

TABLE X

Variations in the Proportions of *Alpheopsis aequalis* Coutière

Specimen	A	B	C	D	E	F	G	H	I	J	K	L	M
Length of carapace in mm.	3.74	3.24	5.89	2.89	3.42	4.05	4.16	3.74	4.38	5.45	3.74	3.3	3.2
No. of seg. of antenna before division	3	2	4	1	2	2	2	2	2	2	3	3	3
Length of rostrum ¹	G1	E1	G1	E2	M2	M2	L1	L1	G1	G2	L1	L1	E1
Length of stylocerite ¹	G2	G1	E3	M3	M3	E3	M3	M3	M3	E3	E2	M2	L3
Proportions of carpal segments and chela of second cheliped.	1	1	1	1	1	1	X	1	1	1	1	1	1
(Relative to the first carpal segment)	0.38	0.4	0.445	0.475	0.45	0.50	X	0.465	0.4	0.425	0.371	0.485	0.324
3rd	0.36	0.374	0.445	0.475	0.45	0.544	X	0.44	0.428	0.41	0.46	0.428	0.324
4th	0.38	0.374	0.445	0.475	0.415	0.50	X	0.405	0.428	0.425	0.485	0.428	0.324
5th	0.36	0.4	0.555	0.715	0.685	0.665	X	0.066	0.713	0.75	0.514	0.428	0.405
Chela	0.62	0.75	0.89	1.00	0.97	1.00	X	1.00	1.14	1.38	1.00	0.86	0.81
Proportions of length and width of carpal segments of second chela	7	6.7	5	3	4.15	4.3	X	3.86	3.18	4.0	4.38	5.0	5.0
1st	2.7	2.66	2.22	1.68	1.86	2.14	X	2.00	1.4	1.44	1.85	2.43	2.00
2nd	2.1	2.14	2.00	1.68	1.63	2.28	X	1.85	1.5	1.36	2.28	1.87	2.00
3rd	2.0	1.88	1.8	1.68	1.33	1.86	X	1.75	1.5	1.31	2.12	2.14	1.715
4th	1.9	2	2.38	2.14	1.9	2.22	X	2.22	2.0	2.31	1.80	2.14	1.875
5th	8.75	11	7.3	6.66	6	5.20	5.5	6.00	5.38	X	7.0	5.0	9.33
Dactylus	14.3	15	14	11.7	12.4	9.45	10.5	11.5	9.55	X	10.07	10.0	7.15
Propodus	6.25	6.25	5.85	6.45	4.0	4.5	6.12	4.28	4.5	X	5.50	6.25	5.23
Carpus	7.3	7.8	6.76	6	6.66	6.54	5.55	5.34	5.3	X	6.08	6.84	5.00
Merus	0.44	0.57	0.356	0.33	0.376	0.36	0.33	0.376	0.308	X	0.447	0.305	0.51
Dactylus	1.25	1.17	1.13	1.17	1.19	1.00	1.05	1.15	0.9	X	1.01	0.976	0.908
Propodus	0.625	0.65	0.575	0.75	0.50	0.53	0.55	0.587	0.539	X	0.647	0.61	0.728
Carpus	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	X	1.00	1.00	1.00
Merus	2	2	2	1	1	1	1	1	1	X	2	0	2
No. of spines on ischium of 3rd leg	8.8	9.3	7.5	8.35	X	7.00	X	X	5.66	6.25	X	8.40	7.88
Length/width merus of second leg.													

Specimens designated by letter are as follows: A, female (ovig.) from Savaii, Oct. 18; B, male from Savaii, Oct. 17; C, female (ovig.) from Savaii, Oct. 15; D, female from Savaii, Oct. 15; E, male from Savaii, Oct. 17; F, male from Savaii, Oct. 17; G, female from Savaii, Oct. 15; H, female from Savaii, Oct. 15; I, female (ovig.) from French Somaliland, coll. by Dr. B. Brown; J, female from Somaliland, coll. by Dr. B. Brown; K, female from Cayo Cristo, 4 miles N. of Isabella, 25 miles N. of Laguna la Grande, Cuba, dredged from 3-4 ft. depth, coll. by Dr. B. Brown; L, female from Bermuda, from broken up masses of coral (6-8 ft. depth, coll. by author; M, female from Barahona Harbor, Santo Domingo, dredged in 12-18 ft., coll. by author.

¹ L1, falls short of end of first segment; E1, reaches to end of first segment; G1, exceeds first segment; M2, reaches to middle of second segment; E2, reaches to end of second segment; G2, exceeds second segment; M3, reaches to middle of third segment; L3, falls short of end of third segment; E3, reaches to end of third segment.

As shown in figure 1, the development of the pterygostomial spine is extremely variable and does not afford any basis for specific distinction. The proportions of the appendages measured (Table X) likewise present no discontinuity sufficiently marked to serve as a specific character in the material available. The Atlantic material differs from most of the Pacific specimens in having smooth unarmed posterior borders on the pleura. However, this character also shows a considerable range of variation (Fig. 1) and, as one of the females from Savaii has pleura almost identical with those of the Atlantic specimens, it does not seem possible to separate the Atlantic and Pacific forms as distinct species on the basis of this character. A single point of difference remains between Coutière's descriptions of *aequalis* and our material. The female collected at Bermuda was marked with broad, vertical, red bands on a transparent body and two of the females from Savaii still show traces of a similar color pattern while the specimens collected by Coutière at Djibouti were said to be uniformly orange.

In view of the wide variation in the morphological characters studied and the lack of information concerning the range of variation in the color pattern, I think that it may be concluded that we are here dealing with a single widely distributed and variable species which must then be given the name of *Alpheopsis aequalis* Coutière.

Crangon crockeri, new species

Figures 2 and 3

SPECIMENS COLLECTED.—Type, 1 male. A.-M.N.H. Cat. No. 9205. From broken up masses of coral, shallow water, eastern reef, Mataatu Harbor, Savaii, Oct. 15.

DESCRIPTION OF TYPE.—The rostrum, one and one-half times as long as wide at the base, falls short of the second antennular article by about two-thirds of the length of the rostrum. The orbital hoods are armed with slender spines which fall short of the end of the rostrum by one-third of the length of the rostrum.

The stylocerite reaches to the end of the first antennular article. The second antennular article is 2.4 times as long as wide and 1.7 times as long as the second.

The basicerite is armed with a strong spine that reaches to the basal articulation of the

carpocerite. The scaphocerite, slightly less than 3 times as long as wide, is equivalent in length (including the terminal spine) to the antennular peduncle. The carpocerite, slightly more than 4.5 times as long as wide, exceeds the antennular peduncle by a very small amount. (On the left side of the type this appears to be about 0.16 of the length of the terminal segment of the antennular peduncle when the carpocerite is placed directly under that appendage.)

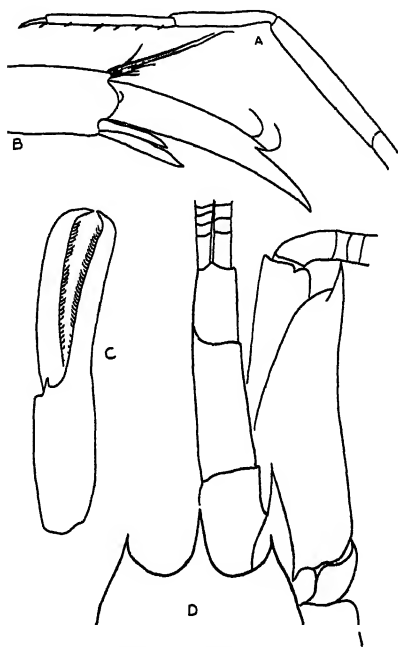


Fig. 2. *Crangon crockeri*, new species
A, third leg; B, dactyl of same leg; C, small first chela; D, frontal and antennal structures.

The third maxillipeds fall short of the end of the antennal peduncle by a little less than one third of the length of their terminal segment. The ultimate segment is 1.4 times the length of the penultimate.

The merus of the larger chela, 2.6 times as long as wide, is unarmed on the upper margin but bears 11 small spinules along the lower margin, in addition to the strong spine which forms the distal extremity of that margin. The chela is 3 times as long as wide. The truncate finger is 0.28 times as long as the palm.

The merus of the smaller chela, 2.8 times as long as wide, is unarmed along the upper margin but bears 13 small spinules along the lower border in addition to the strong spine which forms the distal extremity of that margin. The chela is 4.8 times as long as wide. The fingers, 1.2 times as long as the palm, are slender and slightly

curved. The cutting edge of the fingers bears a comb-like row of stout, curved setae on both sides while the cutting edge itself is sculptured by a series of very fine obliquely transverse ridges.

The carpal segments of the second pair of chelae are in the ratio: 1st (proximal) 1.0; 2nd 0.6; 3rd 0.33; 4th 0.35; 5th 0.54; chela 0.77.

The merus of the third legs is 7.2 times as long as wide. The propodus is armed with five spinules along the posterior margin and a pair at the distal extremity. The dactylus bears a small accessory claw on the upper margin at about the distal third of its length. A pair of curved setae arises just behind this accessory claw.

The telson is 1.8 times as long as wide at the base.

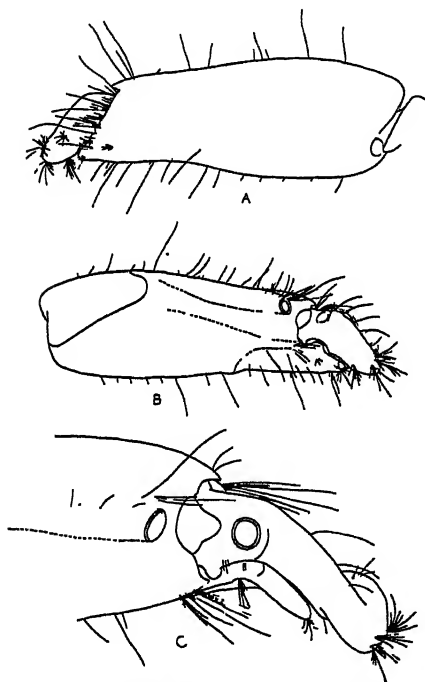


Fig. 3. *Crangon crockeri*, new species

A, large first chela, inner side; B, outer side of same chela; C, dactyl and anterior portion of palm of same chela.

DISCUSSION.—*C. crockeri* appears to be most closely related to *C. assimulans* (de Man) and only slightly less so to *C. hailstonei* (Coutière). From both these species *crockeri* may be distinguished by the complete absence of the transverse groove on the inner face of the large chela. Both de

Man's¹ figure of *assimulans* and Coutière's² of *hailstonei* show this groove to be represented by a conspicuous notch. Also the fourth carpal article of *crockeri* is shorter than either the second or the fifth while in *assimulans* it is "...usually as long as the second and as long as the fifth"¹ and in *hailstonei* it is "as long as the second and as long as the fifth."²

Crangon collumianus (Stimpson)

Alpheus collumianus STIMPSON, W., 1860, Proc. Phil. Acad. Nat. Sci., p. 30.—DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 334.

SPECIMENS COLLECTED.—1 female from broken up masses of coral, depth 2.3 feet, west of anchorage, Mataatu Harbor, Savaii, Oct. 18.

Crangon ventrosus (H. Milne-Edwards)

Alpheus ventrosus MILNE-EDWARDS, H., 1837, Hist. Nat. Crust., p. 352.—DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 207.

SPECIMENS COLLECTED.—10 males, 10 females (4 ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 4 males, 7 females (2 ovigerous), from broken up masses of coral, depth 3–5 feet, same locality, Oct. 16. 11 males, 17 females (10 ovigerous), 2 young, from broken up masses of coral, depth 8 feet, same locality, Oct. 17. 4 males, 6 females (4 ovigerous), from broken up masses of coral, depth 8 feet, same locality, Oct. 18.

Crangon obesomanus (Dana)

Alpheus obesomanus DANA, J. D., 1852, U. S. Explor. Exped. Crust., I, p. 547, Pl. XXXIV, fig. 7.

SPECIMENS COLLECTED.—1 male, 1 female (ovigerous) from broken up masses of coral, depth 8 feet, Mataatu Harbor, Savaii, eastern reef, Oct. 17.

Crangon phrygianus (Coutière)

Alpheus phrygianus COUTIÈRE, H., 1905, Mald. and Lacc. Arch., p. 886, Pl. LXXVI, fig. 25.

SPECIMENS COLLECTED.—1 female from broken up coral masses, depth 6 feet, Mataatu Harbor, Savaii, Oct. 18.

¹ 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 199, Pl. xrv, fig. 64.

² 1905, Mald. and Lacc. Arch., p. 879, Pl. LXXIV fig. 18.

Crangon alcyone (de Man)

Alpheus alcyone DE MAN, J. G., 1903, Abhand. Senck. Natur. Gesell., XXV, p. 870, Pl. xxvii, fig. 61.

Alpheus aculeipes COUTIERE, H., 1905, Mald. and Lacc. Arch., p. 892, Pl. LXXIX, fig. 31.

Alpheus alcyone DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 351.

SPECIMENS COLLECTED.—6 ovigerous females and 3 males from broken up masses of coral, depth 6 feet, Mataatu Harbor, Savaii, Oct. 18.

Crangon frontalis (H. Milne-Edwards)

Alpheus frontalis MILNE-EDWARDS, H., 1837, Hist. Nat. Crust., II, p. 356.

Alpheus latifrons DE MAN, J. G., 1888, Archiv f. Naturg., LIII, p. 521, Pl. xxii.

Alpheus frontalis DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 369.

SPECIMENS COLLECTED.—1 male, 1 female from anchorage, Mataatu Harbor, Savaii, Oct. 16.

Crangon gracilipes (Stimpson)

Alpheus gracilipes STIMPSON, W., 1860, Proc. Phil. Acad. Nat. Sci., p. 31.—DE MAN, J. G., 1911, "Siboga" Exped. Mongr. XXXIX a1, p. 380.

SPECIMENS COLLECTED.—4 females (2 ovigerous), 2 males from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 1 female (ovigerous) from broken up masses of coral, depth 3-5 feet, same locality, Oct. 16. 1 female (ovigerous) from broken up masses of coral, depth 8 feet, same locality, Oct. 17. 1 male from broken up masses of coral, depth 6 feet, same locality, Oct. 18.

Crangon parvirostris (Dana)

Alpheus parvirostris DANA, J. D., 1852, U. S. Explor. Exped., Crust., I, p. 551, Pl. xxxv, fig. 3.

SPECIMENS COLLECTED.—4 males, 4 females (3 ovigerous) from broken up coral masses, depth 6 feet, Mataatu Harbor, Savaii, Oct. 18.

Synalpheus theophane de Man

Synalpheus theophane DE MAN, J. D., 1910, Tijdschr. d. Ned. Dierk. Vereen., (2) XI, p. 292.

SPECIMENS COLLECTED.—2 females (ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15.

Saron marmoratus (Olivier)

Saron marmoratus BORRADALE, L. A., 1898, Proc. Zool. Soc. London, p. 1009 (syn.).—KEMP, S., 1914, Rec. Ind. Mus., X, p. 84 (syn.).

SPECIMENS COLLECTED.—1 male from anchorage, Penrhyn Island, "caught off boat near submerged light," Sept. 25. 1 female from anchorage, Pago Pago, Samoa, caught near submerged light, Oct. 10. 3 females (1 ovigerous) from broken up coral masses, depth 3-5 feet, Mataatu Harbor, Savaii, west reef, Oct. 16. 1 female from broken up coral masses, depth 8 feet, Mataatu Harbor, Savaii, Oct. 17.

Saron neglectus de Man

Saron neglectus DE MAN, J. G., 1903, Abhand. Senck. Natur. Gesell., XXV, p. 854, Pl. xxvi, fig. 58.

SPECIMENS COLLECTED.—1 male, 1 female (ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 1 male, 2 females (1 ovigerous) from broken up masses of coral, depth 3-5 feet, Mataatu Harbor, Savaii, west reef, Oct. 16. 6 males, 9 females (8 ovigerous) from broken up coral masses, depth 8 feet, same locality, Oct. 17.

Lysmata zaca, new species**Figure 4**

SPECIMENS COLLECTED.—Holotype, 1 female, carapace length 5.1 mm., Cat. No. A.M.N.H. 9204, from broken up masses of coral, depth 8 feet, Mataatu Harbor, Savaii, eastern reef, Oct. 17; paratypes, 1 female, 1 male, same locality, Oct. 15.

DESCRIPTION.—The rostrum, reaching to the end of the second antennular article, bears 6 teeth (the three posterior ones being on the carapace) on the straight upper margin and 4 much smaller teeth on the lower margin, the first lower tooth being placed just anterior to the penultimate dorsal tooth. The proximal unarmed portion of the lower margin is concave; the distal portion bearing the teeth is gently convex.

The large antennal spine is the only spine present on the carapace.

The lateral process of the first antennular article is very small and almost completely concealed by the eyes. It is sharply pointed anteriorly and reaches about one-third the length of the first segment. The fused part of the inner antennular segment is composed of 6 segments and is about one and one-half times as long as the thicker ramus of the free portion.

The antennal scale which reaches to the end of the antennular peduncle is slightly less than

five times as long as wide and has nearly parallel margins. The concave outer margin terminates in a spine which does not exceed the blade.

The third maxillipeds exceed the antennular peduncle by about one-half the length of the penultimate article, the latter being one-half the length of the ultimate.

The first pereopods are slender and exceed the antennular peduncle by the length of the chela. The carpus is a little over one and one-half times as long as the merus and a little less than one and one-half times as long as the chela. The fingers of the chela have unarmed cutting edges, slender acute tips which cross when the claw is shut. The fingers are a little less than one-half

most conspicuous, those of the propodus the smallest with the spinules on the carpus about intermediate in size. The dactylus bears 5 large teeth (including the terminal) increasing in size distally. The fifth leg reaches beyond the antennular peduncle by the dactylus and about one-half the length of the propodus.

The fifth abdominal segment, measured dorsally, is three-fourths as long as the sixth. The telson is about one and one-half times as long as the sixth abdominal segment and shorter than either pair of uropods. Besides the two pairs of dorsal spines present in all three specimens, the type and the cotype have an extra, fifth spine on one side only; on the right in the type and on the left in the cotype. The lateral margins are setose over the posterior half of their length. The narrow apex, minutely pointed in the center, bears two pairs of spines on either side, the innermost being the longest. Inside of these innermost spines lie a pair of plumose setae so heavy that they give the appearance of another pair of terminal spines. They are a little shorter than the innermost pair of spines.

REMARKS.—Among the Pacific species of *Lysemata*, *zacae* resembles *acicula* (Rathbun)¹ and *seticaudata* var. *ternate* de Man² in the length of the rostrum. From *acicula* it may be distinguished by the antennal scale. This reaches to the end of the antennular peduncle in *zacae* and "...exceeds considerably the antennular peduncle and is nearly as long as the carapace, rostrum excluded" in *acicula*. Although Miss Rathbun states that in *acicula* the third maxilliped exceeds the antennal scale by only one-half the terminal segment and in *zacae* it exceeds that appendage by the whole of the terminal segment and half of the penultimate, this may be but another way of stating the difference in the length of the antennal scale. In her species the scale is nearly as long as the carapace while, in both of our two specimens still retaining these appendages, the scale is a little less than three-fourths the length of the carapace. The small difference in the number of carpal articles of the second pair of pereopods, 32 in *zacae* and 29 in *acicula* may be due to individual variation. The small number of specimens; 5 mentioned by Miss Rathbun and 3 of *zacae* do not allow any analysis of that point. The only other characters given by Miss

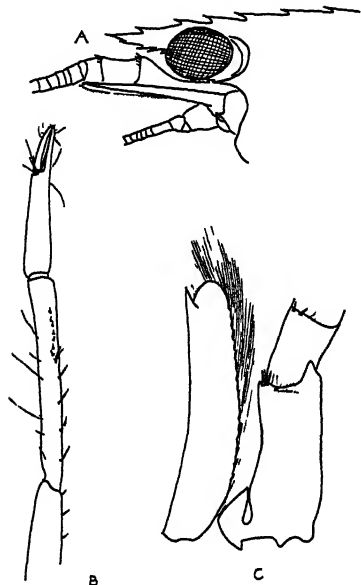


Fig. 4. *Lysemata zacae*, new species

A, frontal and antennal structures; B, first chela; C, antennal scale and basal portion of the antennular peduncle.

(0.425 in the female paratype) times as long as the palm.

The second pair of pereopods reach beyond the antennular peduncle by the chela, carpus and one-fourth the length of the merus. The ischium and merus are annulate and the carpus consists of 32 segments. The chela is one and one-half times as long as the last carpal segment. The fixed finger and the dactylus are about equal in length and both bear two small teeth at the apex, the dactylus being as long as the palm.

The third leg reaches beyond the antennular peduncle by all of the dactylus, carpus and propodus. The merus, carpus and propodus are armed with a series of spinules along the posterior margin, those of the merus being the

¹ 1909, Bull. U. S. Fish. Comm., XXIII, pt. 2, p. 912.

² 1903, Abhand. Senck. Natur. Gesell., XXV, p. 846.

Rathbun which may be compared with our specimens are the length and armature of the rostrum. Those are in complete agreement. From *seticauda* var. *ternate*, *zacae* may be distinguished by the free portion of the inner antennular peduncle being shorter than the fused part in *zacae* and longer in *seticauda* var. *ternate*. It is further excluded from de Man's species by the greater number of carpal segments in the second pair of pereopods; 32 in *zacae* and 24 in *seticauda* var. *ternate*.

Thor pascalis (Heller)

Hippolyte pascalis HELLER, C., 1861, Sitz.-ber. Akad. Wiss. Wien., XLIV, p. 276, Pl. III, fig. 24.

Thor pascalis KEMP, S., 1914, Rec. Ind. Mus., X, p. 94, Pl. I, figs. 6-10.

SPECIMENS COLLECTED.—1 male from broken up coral masses, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 1 female (ovigerous) from broken up masses of coral, depth 3-5 feet, same locality, western reef, Oct. 16.

Rhynchocinites hendersoni Kemp

Rhynchocinites rugulosus HENDERSON, J. R., 1893, Trans. Linn. Soc. London, (2) Zool., V, p. 438.

Rhynchocinites hendersoni KEMP, S., 1925, Rec. Ind. Mus., XXVII, p. 265.

SPECIMENS COLLECTED.—1 male, 1 female (ovigerous) from broken up masses of coral, depth 8 feet, Savaii, eastern reef, Oct. 17.

Macrobrachium lar (Fabricius)

Palaemon lar FABRICIUS, J. C., 1798, Supp. Ent. Syst., p. 402.—ORTMANN, A., 1891, Zool. Jahrb. Abt. Syst., V, p. 724 (syn.).

SPECIMENS COLLECTED.—1 male, Kapapa Islet, Oahu, Hawaii, November.

Periclimenes (*Ancylocaris*) *amymone* de Man

Periclimenes amymone DE MAN, J. D., 1903, Abhand. Senck. Natur. Gesell., XXV, p. 829, Pl. XXV, figs. 53a-g.

Periclimenes (*Ancylocaris*) *amymone*, KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 219.

SPECIMENS COLLECTED.—2 females from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 8 females (7 ovigerous), 2 males from

broken up masses of coral, depth 3-5 feet, same locality, western reef, Oct. 16. 1 female, 2 males from broken up masses of coral, depth 8 feet, same locality, Oct. 17.

Periclimenes (*Ancylocaris*) *rotumanus* Borradaile

Periclimenes rotumanus BORRADAILE, L. A., 1898, Proc. Zool. Soc. London, p. 1005, Pl. LXIV, figs. 5-5b.

Periclimenes (*Ancylocaris*) *rotumanus* KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 226.

SPECIMENS COLLECTED.—1 female (ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 1 male from broken up masses of coral, depth 8 feet, same locality, Oct. 18.

Periclimenes (*Ancylocaris*) *spiniferus* de Man

Periclimenes petithouaris var. *spiniferus* DE MAN, J. G., 1903, Abhand. Senck. Natur. Gesell., XXV, p. 824.

Periclimenes (*Flaciger*) *spiniferus*, BORRADAILE, L. A., 1917, Trans. Linn. Soc., (2) XVII, p. 369, Pl. LII.

Periclimenes (*Ancylocaris*) *spiniferus*, KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 195.

SPECIMENS COLLECTED.—2 males from broken up masses of coral, Mataatu Harbor, Savaii, Oct. 14. 1 male from broken up masses of coral, shallow water, same locality, eastern reef, Oct. 15. 1 female (ovigerous), 2 males from broken up masses of coral, depth 3-5 feet, same locality, western reef, Oct. 16. 3 females (ovigerous), depth 8 feet, same locality, eastern reef, Oct. 17. 1 female (ovigerous), 1 male from broken up masses of coral, depth 8 feet, same locality, Oct. 18.

Harpilius depressus Stimpson

Harpilius depressus STIMPSON, W., 1860, Proc. Acad. Sci. Phil., p. 38.—KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 231.

SPECIMENS COLLECTED.—2 females (ovigerous), 1 male from broken up masses of coral, depth 8 feet, Mataatu Harbor, Savaii, eastern reef, Oct. 17.

Harpilius gerlachei Nobili

Harpilius gerlachei NOBILI, G., 1905, Bull. Mus. Paris, XI, p. 160.—KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 238, Figs. 74-75.

SPECIMENS COLLECTED.—1 female (ovi-

gerous), 1 male from broken up masses of coral, depth 3-5 feet, Mataatu Harbor, Savaii, western reef, Oct. 16.

Coralliocaris graminea (Dana)

Oedipus graminea DANA, J. D., 1852, U. S. Explor. Exped., Crust., I, p. 573, Pl. xxxvii, fig. 3a-e.

Coralliocaris graminea, KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 269, Figs. 69-97.

SPECIMENS COLLECTED.—1 male from broken up coral masses, depth 2-3 feet, Mataatu Harbor, Savaii, Oct. 14. 2 females from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15.

Coralliocaris lucina Nobili

Coralliocaris lucina NOBILI, G., 1901, Ann. Mus. Univ. Napoli, (N. S.) I, 3, p. 5.—KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 276, Fig. 102.

SPECIMENS COLLECTED.—1 female from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15. 9 females (6 ovigerous), 3 males from broken up masses of coral, depth 3-5 feet, same locality, western reef, Oct. 16. 4 females (ovigerous), 1 male from broken up masses of coral, depth 8 feet, eastern reef, Oct. 17.

Coralliocaris superba (Dana)

Oedipus superbus DANA, J. D., 1852, U. S. Explor. Exped., Crust., I, p. 575, Pl. xxxvii, figs. 2a-f.

Coralliocaris superba, KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 272, Figs. 98-99.

SPECIMENS COLLECTED.—7 females (ovigerous), 2 males from broken up masses of coral, depth 3-5 feet, Mataatu Harbor, Savaii, western reef, Oct. 16. 2 females (1 ovigerous), 2 males from broken up masses of coral, depth 8 feet, same locality, eastern reef, Oct. 17. 1 female (ovigerous) from broken up masses of coral, depth 6 feet, same locality, Oct. 18.

Coralliocaris venusta Kemp

Coralliocaris venusta KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 274, Fig. 100.

SPECIMENS COLLECTED.—5 females (1 ovigerous), 2 males from broken up masses of coral, depth 3-5 feet, Mataatu Harbor, Savaii, western reef, Oct. 16.

REMARKS.—Kemp described this species from two specimens, one male and one female. His male had a single dorsal tooth on the rostrum, the female two, while both had a single ventral tooth. In the Savaii specimens this character shows somewhat more variation as follows: Females, 1/0, 2/1, 2/1 and 2/2, the remaining female having the rostrum broken so that the teeth could not be counted; males, both 1/1.

Conchodytes tridacnae Peters

Conchodytes tridacnae BORRADAILE, L. A., 1917, Trans. Linn. Soc., (2) XVII, p. 393 (syn.).—KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 283.

SPECIMENS COLLECTED.—1 female, found inside of 3-inch *Tridacna*, Penrhyn Island lagoon, Sept. 22.

Conchodytes meleagrinae Peters

Conchodytes meleagrinae BORRADAILE, L. A., 1917, Trans. Linn. Soc., (2) XVII, p. 393 (syn.).—KEMP, S., 1922, Rec. Ind. Mus., XXIV, p. 285. *Conchodytes biunguiculatus* BOONE, C. P., 1938, Bull. Vand. Mus., VI, p. 184, Pl. L.

SPECIMENS COLLECTED.—1 male, 1 female "found inside of pearl shell," Penrhyn Island, Sept. 20. 1 male "caught by hand and by breaking open coral specimens." East anchorage, 4 feet depth, Mataatu Harbor, Savaii, Oct. 13. 1 male, field data missing.

Gnathophyllum panamense Faxon

Gnathophyllum panamense FAXON, W., 1893, Bull. Mus. Comp. Zool., XXIV, p. 198; 1895, Mem. Mus. Comp. Zool., XVIII, p. 146, Pl. E.

SPECIMENS COLLECTED.—1 female (ovigerous) from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15.

Processa jacobsoni de Man

Processa jacobsoni DE MAN, J. G., 1921, Zool. Med. ut. Rijks. Mus. Nat. Hist. Leiden, VI, p. 95.

SPECIMENS COLLECTED.—1 male from broken up masses of coral, shallow water, Mataatu Harbor, Savaii, eastern reef, Oct. 15.

STOMATOPODA

***Pseudosquilla ornata* Miers**

Pseudosquilla ornata MIERS, E. J., 1880, Ann. Mag. Nat. Hist., (5) V, p. 111, figs. 5, 6.—KEMP, S., 1913, Mem. Ind. Mus., IV, p. 100.

SPECIMENS COLLECTED.—2 males, 2 females from broken up masses of coral, depth 8 feet, Mataatu Harbor, eastern reef, Savaii, Oct. 17. 2 males, 1 female from broken up masses of coral, depth 6 feet, Mataatu Harbor, Savaii, Oct. 18.

***Lysosquilla maculata* (Fabricius)**

Squilla maculata FABRICIUS, S. C., 1793, Ent. Syst., II, p. 511.

Lysosquilla maculata KEMP, S., 1913, Mem. Ind. Mus., IV, p. 111, Pl. VIII, figs. 86–91.

SPECIMENS COLLECTED.—1 male, 155 mm. long, taken at surface near a submerged light about 8 P. M., anchorage, Penrhyn Island, Sept. 23.

***Gonodactylus chiragra* (Fabricius)**

Squilla chiragra FABRICIUS, J. C., 1781, Species Insectorum, I, p. 515.

Gonodactylus chiragra, KEMP, S., 1913, Mem. Ind. Mus., IV, p. 155, Pl. IX, fig. 107.

SPECIMENS COLLECTED.—3 males from broken up masses of coral, shallow water, eastern reef, Mataatu Harbor, Savaii, Oct. 15, 1936. 2 females from broken up masses of coral, depth 8 feet, same locality, Oct. 17.

***Gonodactylus glabrous* Brooks**

Gonodactylus glabrous BROOKS, W. K., 1886, "Challenger" Reports, XVI, p. 62, Pl. XIV, fig. 5; Pl. XV, figs. 7–9.—KEMP, S., 1913, Mem. Ind. Mus., IV, p. 167, Pl. IX, fig. 113.

SPECIMENS COLLECTED.—1 male from broken up masses of coral, depth 8 feet, eastern reef, Mataatu Harbor, Savaii, Oct. 17.

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POLYCHAETOUS ANNELIDS FROM THE NEW ENGLAND REGION, PORTO RICO AND BRAZIL

BY AARON L. TREADWELL

Hesionidae

ANCISTROSYLLIS McINTOSH

Ancistrosyllis tentaculata, new species

Figures 1 to 3

Two specimens collected at Crab Meadow State Park, Long Island, N. Y. One is entire, the other lacks the posterior end. The former is too badly distorted to allow of accurate measurements but is about 5 mm. long and has a maximum width of 1 mm.

The prostomium (Fig. 1) is broadest on the anterior margin which is straight. The lateral margins are faintly curved and bend toward the median body line. Posteriorly there is a deep indentation dividing the prostomium into two bluntly rounded conical lobes whose apices are directed posteriorly. Rather more than one-third of the prostomium overlaps the peristomium. Because of poor preservation the structures at the front of the prostomium are badly defined but apparently they are the palps, the very small lobe on the anterior margin being the terminal joint present in other species of this genus. There are three tentacles, the median attached in the mid-dorsal line at the end of the indentation. The lateral tentacles are at the same level as the median but situated at the prostomial margin. The median tentacle is about one and a half times as long as the prostomium and is drawn as bent back upon itself, the position it occupies in both of the specimens. The lateral tentacles are slightly smaller than the median, their anterior ends reaching beyond the palpal margins. In one specimen, but not visible in the other, pigment spots lie on the prostomial margin just lateral to the point of insertion of the tentacles. These possibly represent eyes.

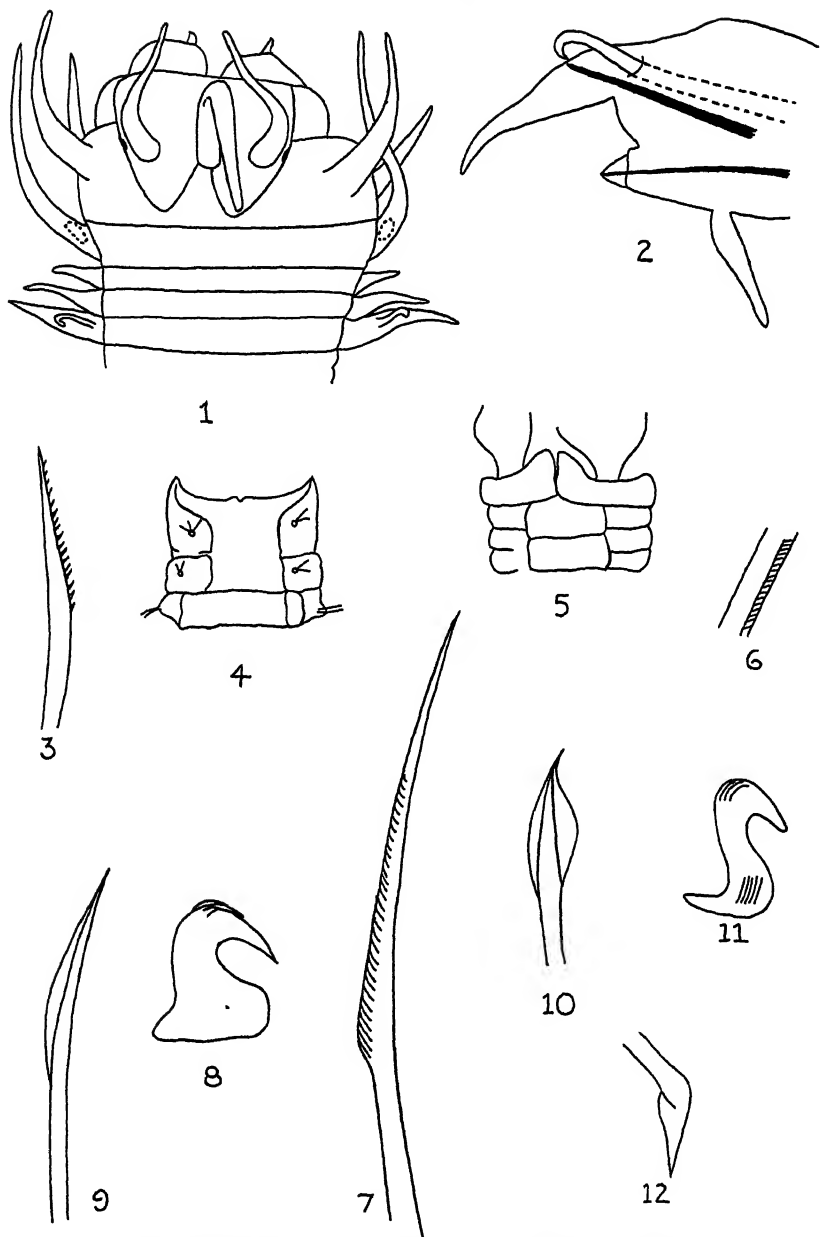
The first somite is about as long as the prostomium and wider than following somites. On either side it carries a pair of tentacular cirri of which the dorsal in each pair is slightly the larger and whose apices extend beyond the palpal margins. The second somite is about one-third as long as the first, its posterior margin narrower than the anterior. Its parapodium has a setal lobe with setae, a long slender dorsal cirrus whose apex reaches beyond the palp and a well-developed ventral cirrus. In both specimens there is as shown in the figure, near

the base of the dorsal cirrus, a rounded translucent area the meaning of which I am unable to guess. The second parapodium is small; it has a dorsal but no ventral cirrus and a setal lobe with setae. The third parapodium is about twice as large as this but its parts have about the same proportionate size while the fourth is considerably larger than the third, its dorsal cirrus being especially noticeable. A prominent feature of this dorsal cirrus is a large colorless spine whose base is imbedded deeply in the parapodium, its slightly bent shaft coming to the surface on the dorsal surface of the dorsal cirrus at its base. Beyond this it extends over the cirrus, its apex bent into a strong hook (Fig. 2). This type of parapodium with spine is found in all subsequent somites except for a very few at the posterior end, which are rudimentary. One anal cirrus remains in the entire specimen but its apex is missing. Apparently it was about as large as the dorsal cirri but less tapering in outline. The ventral cirri are all rather prominent and reach to the ends of the setal lobes. The parapodia are prominent in all cases and in median and later somites are longer than the body width.

The parapodia are rather thick (Fig. 2), the dorsal cirri large. Ventral to the large hooked spine mentioned above is the acicula. The setal lobe has two lips, one pointed and one rounded, the acicula extending into the pointed lip. In the entire specimen seen from the ventral surface the pointed lip is ventral to the rounded one though in the specimen from which the figure was drawn one appears to be anterior to the other. These parapodia are very delicate and it is difficult to avoid distortion in mounting for study. The spine should be understood as coming to the surface nearer the dorsal surface than would be inferred from the figure.

All setae are simple and I could find only two types. The first are slender, acicular and of varying lengths, the others are shorter and thicker and have a row of prominent spines along one margin (Fig. 3). I was unable to find any acicular setae with marginal serrations as described by Southern (1921, Pl. xix, fig. 1g), nor the bifurcate ones figured by Langerhans (1881, Pl. rv, fig. 16b).

The type is Cat. No. 2893, in The American Museum of Natural History.



Figs. 1 to 3. *Ancistrosyllis tentaculata*: 1, head $\times 45$; 2, posterior parapodium $\times 66$; 3, seta $\times 250$.

Figs. 4 to 8. *Laonome sanjuanensis*: 4, dorsal view of anterior somites $\times 7.5$; 5, ventral view of anterior somites $\times 7.5$; 6, detail of collar seta $\times 250$; 7, second type of collar seta $\times 250$; 8, uncinus $\times 250$.

Figs. 9 to 12. *Parasabella minuta*: 9, seta from dorsal end of seta tuft $\times 250$; 10, spatulate seta $\times 250$; 11, uncinus $\times 250$; 12, pennoned seta $\times 250$.

The specimens were in a collection of polychaetes made by the New York State Conservation Commission and sent to me for identification by Dr. H. K. Townes. Other polychaetes from this collection are listed in Biological Survey of the Salt Waters of Long Island, pt. 1, pp. 171-172, 1938, Suppl. to 25th Report of New York State Conservation Commission. The publication of the description here is by permission of the Commission.

The genus *Ancistrosyllis* was first defined by McIntosh (1877, pp. 502, 503; Pl. LXV, fig. 3) from a specimen collected in Davis Strait to which he gave the species name *groenlandica* and he assigned the genus to the family Syllidae. A noticeable feature of this genus is the large dorsal spine found in most parapodia. Langerhans (1881, pp. 107, 108, Pl. rv, fig. 16) gave the name *A. albi* to a specimen from the Canary Islands which he also listed as a syllid but noted it as very aberrant. Korschelt (1894, pp. 279-285, Pl. XIII, figs. 16 to 29) described a series of pelagic annelid larvae from Trieste characterized in the later stages by the large dorsal spines. This he thought closely related to *Ancistrosyllis* but differing from it enough to be assigned to a distinct genus for which he proposed the name *Harpochaeta* with the species *cingulata*. He also thought these were syllids. Ehlers (1908, pp. 59-61, Pl. vi, figs. 4 to 7) gave a more detailed diagnosis of *Ancistrosyllis* than that by McIntosh and he recognized that the genus belongs in the Hesionidae. Ehlers thought that *Harpochaeta* is synonymous with *Ancistrosyllis* and described the species *robusta*, from the Atlantic coast of Africa. Southern (1921, p. 573, Pl. XIX, fig. 1) recorded *A. constricta* from Chilka Lake, India. Fauvel (1923, pp. 250-251, Fig. 94f-k) considers *Harpochaeta* as synonymous with *Ancistrosyllis* and uses *cingulata* as a characteristic species, though this is known only from larval stages. I am unable to follow Fauvel in listing *Ancistrosyllis* as synonymous with Webster's *Cabira* (1879, p. 67, Pl. xi, figs. 155-157). Webster describes and figures a stout spine which he locates in the ventral cirrus but in no other feature

can I find the slightest resemblance to any figures or descriptions of species of this genus or to my own specimens. *A. tentaculata* agrees more closely with *A. constricta* than with any other species thus far described, especially in the form of the tentacles, tentacular cirri and the first four parapodia. The two species differ in the form of the head region, and in setae as mentioned above. In *tentaculata* the hooked spines first appear on the fourth setigerous somite while in *constricta* their first appearance is between the thirtieth and fortieth parapodia. *Tentaculata* also shows no signs of surface tubercles seen in the other species.

Nereidae

Nereis (Neanthes) varia Treadwell

Nereis (Neanthes) paucidentata TREADWELL (name preoccupied), 1939, American Museum Novitates, No. 1023, p. 6, Fig. 25.

Type is Cat. No. 2564, in The American Museum of Natural History.

Collected at Charlestown, Mass., and Groton, Conn.

Sabellidae

LAONOME MALMGREN

Laonome sanjuanensis, new species

Figures 4 to 8

The body-length to base of gills is 33 mm. and its width at the anterior end of the thorax is 3 mm. On either side are twenty gill-filaments of varying lengths, none over 12 mm. long, all unusually slender and united only at their bases. The barbules are all very delicate and short. There are no dorsal appendages and no eyes. The tentacles are broad at their bases and about 1.75 mm. long. In no part of the body is there any especial pigmentation, the general body-color being light brown, the tentacles slightly paler than the body. The thorax is composed of six somites, the remainder of the body of between eighty and ninety. The collar is two-lobed and inconspicuous. The halves are widely separated dorsally (Fig. 4); ventrally (Fig. 5) each lobe widens into a triangular flap whose apex extends anteriorly between the bases of the gills. These flaps are in contact but do not noticeably overlap. In the preserved material the first three somites are slightly narrower than the fourth, while somites behind this narrow gradually toward the posterior end of the body.

The collar setae are of two kinds. The first are long and slender and faintly limbate, the

marginal wing striated (detail, Fig. 6). The second are shorter than the first and protrude to a shorter distance from the body surface than do they. They are faintly geniculate, widen just distal to the bend and then narrow to a sharp point. The convex margin is noticeably striated but not at all denticulate (Fig. 7). In the other thoracic somites essentially the same forms of setae occur. In the abdomen are both long and short setae, as in the thorax, but there is a much greater degree of similarity between the two. Uncinigerous tori begin on somite 2, each carrying a single row of uncini. The latter are alike in thorax and abdomen, each (Fig. 8) with one prominent tooth and a few others on the crest, the precise outlines of the latter being difficult to determine. There is no basal prolongation.

The type is Cat. No. 2892, in The American Museum of Natural History.

Collected in a tidal pool, north side of Island, East San Juan, Porto Rico, by S. Matlupse.

PARASABELLA BUSH

Parasabella minuta, new species

Figures 9 to 12

The characters of the collar and setae place these specimens in *Sabella* as defined by Fauvel (1927, p. 296) or *Parasabella* Bush (1904, pp. 199-200). They live in thin-walled tubes which have a light outer coating of sand grains. In the type the length of body to the base of the gills is 13 mm., the gills being 3 mm. long. The greatest width, near the anterior end, is about

0.75 mm. On either side are seven gill-filaments, the radioles being rather heavy, the barbules in length about four times the radiole diameter. The apex of the radiole is naked. In the middle region of each radiole are a few dark eye-spots, the number varying in different radioles. The collar is very low and two-lobed, the ends widely separated dorsally but overlapping ventrally. In the collar fascicle the setae are geniculate with a striated wing on the convex margin (Fig. 9), the dorsalmost ones longer and more slender than the ventral. There are five somites in the thorax, the four following the one above described having dorsal setae and ventral uncini. The setae show gradations from those like the collar setae in the dorsal part of the tuft to a spatulate type at the ventral end. These (Fig. 10) are short and have acute apices and wings on both sides of the stalk. So far as I could determine all abdominal setae are of the long slender type. In the thoracic tori are uncini in a row of five to eight and ventral to these an equal number of pennoned setae. The uncini (Fig. 11) have a single large tooth and their apices are striated rather than toothed. The pennoned setae (Fig. 12) are smaller than the uncini. Only uncini are present in abdominal tori, these being similar in form to those of the thorax.

There is reason to believe that immature sabellids have fewer somites than do the adults, and since five is an unusually small number of thoracic somites it seems probable that these are immature.

The type is Cat. No. 2894, in The American Museum of Natural History.

Collected at Island of São Sebastião, Brazil.

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NEW SPECIES OF POLYCHAETOUS ANNELIDS FROM THE VICINITY OF GALVESTON, TEXAS

By AARON L. TREADWELL

The following two new species of polychaetous annelids appeared in a collection from the vicinity of Galveston, Texas, sent me for identification by Professor Willis G. Hewatt of the Texas Christian University, Fort Worth, Texas.

Ariciidae

SCOLOPLOS BLAINVILLE

Scoloplos rufa, new species

Figures 1 to 6

The type is incomplete posteriorly but retains about 200 somites and is 96 mm. long. Its greatest diameter is 1 mm. The color (in preserved material) is dark reddish brown. The prostomium (Fig. 1) is conical and is about as long as the first somite. No eyes are visible. The protruded pharynx (Fig. 2) is much convoluted and is supported on a narrow stalk. The second somite is about three-quarters as long as the first and later ones are about equal to these in length. Anteriorly the body is round in cross section but from the region of about the 25th somite and with the development of the gills it becomes more and more flattened on the dorsal surface and the somites are shorter and much crowded. In anterior somites the setae arise direct from the body wall with no indication of parapodia but there is a distinction between a notopodial and a neuropodial tuft. Posterior to the 12th setigerous somite (I was unable to find it anterior to this point) a rounded cirrus-like lobe, shorter than the setae, arises posterior to the notosetal tuft (Fig. 3 of the 15th setigerous somite). By the 20th setigerous somite this has developed into a prominent notopodial lobe (Fig. 4). Another but much smaller lobe appears on the dorsal neuropodial surface. From the 13th to the 25th setigerous somites there is a gradual shifting of the parapodia from a lateral to a dorsal position and posterior to the 25th the notopodial lobe is definitely dorsal and the neuropodial dorsolateral in position. The gills begin as small cirrus-like structures on either side of the median dorsal line in setigerous somite 26 and in later somites increase in size as do the notal cirri so that gills and cirri form a prominent transverse row on the dorsal surface of each somite (Fig. 5) which

represents one-half of the cross section of a somite showing dorsal and ventral parapodial lobes with setae and gills. In some somites there are two gills, one on either side. In the one drawn there were four, the two median ones united at their bases. Because of the crowded condition of the somites and the fact that the gills are so easily dislodged, whether there is any definite distribution of the two- and four-grouped gills, I am unable to state. One specimen has a smooth cylindrical pygidial region devoid of appendages. Assuming that this is normal and not a regenerating condition it is markedly different from the condition described by McIntosh (1908) for *S. armiger* in British Annelids (Ray Society Publication), II, p. 512.

The setae are all essentially alike, differing only in their relative lengths. They have slender axes, terminating in sharp points and at a short distance outside the body wall they become bilimbate. Beginning at this point the shaft is crossed by series of parallel lines of which a detail taken from about the middle of the seta is shown in Fig. 6. In profile these lines can be seen to be the expression of minute plates which slightly protrude distally so that they give the profile a minutely toothed structure.

The type is Cat. No. 2895, in The American Museum of Natural History.

Collected at Offats Bayou, Galveston.

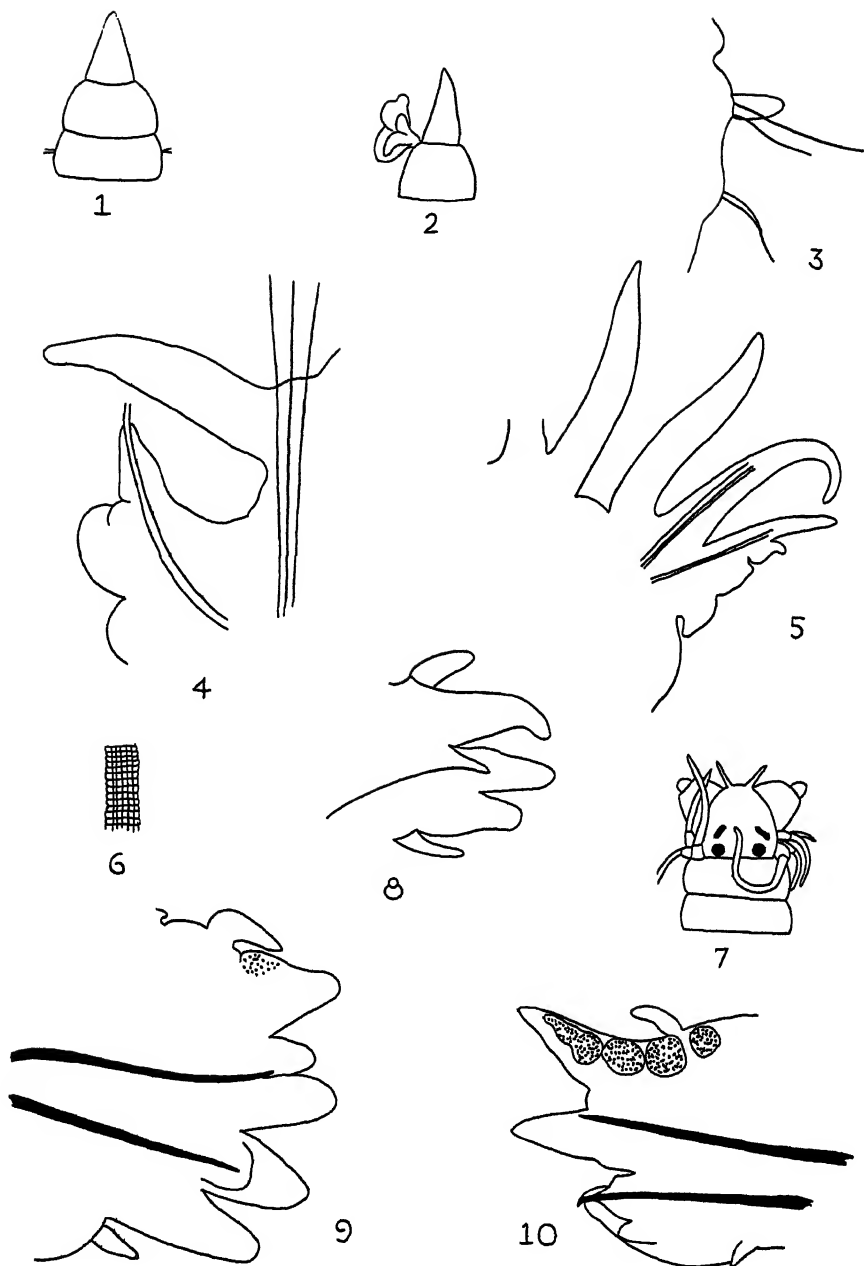
Nereidae

LEPTONEREIS KINBERG

Leptonereis nota, new species

Figures 7 to 10

A single specimen lacking the posterior end. What remains is 55 mm. long and has a posterior width of 1 mm. The body is widest at about somite 6 and from here it tapers slightly toward the head and more noticeably posteriorly. The preserved specimen has a dark brown color due to pigmentation which is especially noticeable in the parapodial lobes. In addition there is in all but the first two or three parapodia a dark pigment patch on the dorsal surface of the notopodium near its base and a lighter one on the ventral surface of the body near the neuropodial base. At about somite 50 the dorsal notopodial patch begins to extend on to the



Figs. 1 to 6. *Scoloplos rufa*: 1, anterior end, $\times 14$; 2, lateral view of anterior end showing protruded pharynx, $\times 14$; 3, fifteenth parapodium, $\times 48$; 4, twentieth parapodium, $\times 48$; 5, section of right half of a posterior somite, $\times 32$; 6, detail of seta structure, $\times 350$.

Figs. 7 to 10. *Leptonereis nota*: 7, anterior end, $\times 5.6$; 8, first parapodium, $\times 45$; 9, seventh parapodium, $\times 31.5$; 10, eightieth parapodium, $\times 31.5$.

dorsal median surface of each somite and in posterior somites is a narrow, nearly continuous band across the somite.

The pharynx is protruded, which may have led to distortion in the head region but in its present condition the prostomium (Fig. 7) is somewhat broader than long and its lateral margins merge into the basal joints of the palps so that the lines between are indistinct. The tentacles are slender and extend about to the apices of the basal palpal joints and are widely separated at their bases. The terminal palpal lobe is rounded and small. The tentacular cirri are all small, the posterior dorsal one being the longest and in the present condition of the specimen it extends to the fourth somite. The posterior eyes are situated near the posterior prostomial border and are round in outline, the anterior ones smaller and linear in outline. The latter are placed so that their longer diameter lies at an angle to that of the body. There are no paragnaths. The first somite is somewhat shorter than the prostomium, following ones are about the same as the first.

In the genus *Leptonereis* the first two parapodia are uniramous. In *L. nota* (Fig. 8), the first parapodium has only the neuropodium, the notopodium being represented by a single lip without setae or aciculae. This notopodial lip is heavy, rounded at the apex and has pigment patches on dorsal and ventral surfaces near its base. The neuropodium has two relatively heavy, rounded lobes with posterior to them a small setal lobe into which the acicula extends. The dorsal and ventral cirri are relatively small, the dorsal one being the larger, and are devoid of pigment. The seventh parapodium (Fig. 9) has a notopodium of two heavy, blunt lobes and a smaller setal lobe between them, the

neuropodium similar to that of the first but larger and heavier. The dorsal and ventral cirri are smaller than in the first but not noticeably different in shape. In the posterior body region is a very noticeable change in parapodial structure. Here (Fig. 10) the notopodium is composed of two well-separated conical lobes with a heavy acicula coming to the surface between them. The dorsal cirrus is small and situated well toward the base of the parapodium. A row of heavy pigmentation extends along the dorsal surface. I could find no definite setal lobe. The neuropodium is much smaller than in anterior somite and is made up of a bluntly rounded lobe posterior to which are two smaller ones, one of which is acutely pointed, the other short and broad with acute apex. The ventral cirrus is very small and easily overlooked. It is situated at the base of the parapodium.

Setae are poorly developed, there being comparatively few in anterior somites and fewer in posterior ones. In anterior parapodia were a number of stout basal joints all homogomphous and lacking the terminal joints. Among these were two or three much smaller ones also homogomphous and with slender pointed terminal joints faintly toothed along one margin. In posterior parapodia I found only one seta in the notopodium and not more than eight in the neuropodium. All lacked the terminal joints but the two kinds of basal joints found in anterior somites appear here. I am uncertain whether there are really two kinds or whether these represent older and younger stages of one kind.

The type is Cat. No. 2896, in The American Museum of Natural History.

Collected at Offats Bayou, Galveston, Texas.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. No. 36

REMARKS ON SOME OLD WORLD LEAF-NOSED BATS

By G. H. H. TATE

When reviewing recently the genus *Hipposideros*,¹ it became necessary to study other available hipposiderine genera, to re-examine *Rhinolophus*, and to some extent to study the remaining leaf-nosed bats, the Megadermidae and Nycteridae.

Material referable to *Asellia*, *Anthops*, *Cloeotis*, *Triacnops*, *Coelops*, *Rhinolophus*, *Megaderma*, *Lavia*, *Nycteris*, *Lyroderma* was examined. (*Rhinonycteris* is apparently unrepresented in American collections.) Notes made upon their comparative structures are presented herewith. The hipposiderine genera are considered first, then briefly the Nycteridae and Megadermidae. The isolated position of *Coelops* is pointed out. Only incidental remarks are offered on the Rhinolophinae, reviewed two years ago² and now in course of extensive revision by C. C. Sanborn.

A list of materials belonging to these genera contained in the Archbold collections is appended.

Hipposiderinae

ANTHOPS THOMAS

Anthops THOMAS, 1888, Ann. Mag. Nat. Hist., (6) I, p. 156; 1888, Proc. Zool. Soc. London, p. 477.—MILLER, 1906, Bull. U. S. Nat. Mus., LVII, p. 113.

GENOTYPE.—*A. ornatus* Thomas from Aola Guadalcánar.

Thomas distinguished *Anthops* from *Hipposideros* by its short tail, which Miller says is less than half the length of the femur and contains four caudal vertebrae, and by the projections of the transverse noseleaf being "rounded and hollow behind." Miller indicated the larger size of

the cochleae (not so large, however, as in *H. muscinus*).

Many of the following notes are based upon specimens kindly lent us by the Curators of Mammals at Washington, Chicago and Cambridge.

Anthops ornatus Thomas

U.S.N.M. 123441, Guadalcánar.

Ears much as the "emarginate ears" of members of *Hipposideros*, but with antitragal fold somewhat larger. Horseshoe with two lateral leaflets, the inner quite small, the outer large. Transverse leaf with three raised, rounded processes, each hollowed out behind and each representing the extension of the three thickened septa which in front support the leaf (as in *H. larvatus*). The transverse leaf subtended by two small lateral leaflets of its own, separate from those margining the horseshoe. Traces of a small frontal sac. Tail very short.

Skull of the short, massive type seen in *Hipposideros speoris* and *larvatus*. Broken. The rostral portion triangular, the rostral swellings at the apices of the triangle not extremely prominent. Infraorbital foramen inclosed by a bar. Intertemporal constriction pronounced. Cochlea and ring not greatly enlarged (diameters 3.4 and 2.8). Back of palate level with m². Incisive foramina closed by maxilla. Back of premaxillae rounded. External lobe of incisors virtually obsolete; c with low posterior cusp; p² neither greatly reduced (cingulum length, 0.7) nor wholly out of toothrow; m³ with partly reduced W-pattern; rami of mandibles at symphysis forming a narrow inverted V; outer incisors slightly thickened, inner ones strongly overlapping;

¹ "Results of the Archbold Expeditions. No. 35," 1941, Bull. Amer. Mus. Nat. Hist., LXXVIII, Art. 5.

² Tate and Archbold, 1939, Amer. Mus. Novit., No. 1036, pp. 1-12.

p_2 unreduced, $\frac{\text{cingulum length } p_2}{\text{cingulum length } p_4} = \frac{1.10}{1.15}$

Back of skull destroyed.

Sanborn records the species from Choi-seul, Troughton from Ysabel and Bougainville Islands.

Contrary to statements by authors, *Anthops* is not very close to *Asellia*. It differs in several features: its much heavier incisors, the retention of p^2 , the form of rostrum and sagittal crest, the less reduced m^3 and p_2 .

The type of *A. ornatus*, B.M. 88.1.5.16, old adult female, two paratypes, B.M. 88.1.5.17 and 88.1.5.28, female and male, and a juvenal male topotype, B.M. 89.4.3.5, all in alcohol, were examined by me. The forearms measured 50, 51, 48.5 and 37 mm., respectively.

My measurements of the type skull are: greatest length, 20.0 mm.; zygomatic breadth, 10.4; mastoid breadth, 9.0; breadth of braincase, 8.4; least inter-orbital width, 2.0; cochlea, 3.0; c-m³, 7.0.

"*Rhinolophus*" *tricuspidatus* Temminck

A.M.N.H. 109987, Hollandia, Dutch New Guinea.

A quite small species with horseshoe unnotched in front, two lateral leaflets, the outer pair connecting with the transverse leaf above and uniting in front beneath the horseshoe; no lateral cells as in *Triaenops*; no papilla-like process on "sella," transverse leaf divided into three parts somewhat as in *Asellia tridens*, but the lateral processes much less elevated. Ears shaped as in *H. galeritus*, although somewhat narrower and more acute and thus approaching *H. muscinus* in form. Tail considerably exserted beyond membrane.

Skull somewhat narrow, the zygomata only slightly exceeding mastoid width, and rostral expanse only slightly less. Rostral swellings large, high. Zygomatic eminence rising gradually in front; high behind. Cochlea rather large and fairly close together (2.1 : 1.0). Premaxillae weakly united, their contact with palate V-shaped.

Upper incisors clearly bilobate, but very small and with the roots exceedingly delicate, divergent, placed at the outer corners of the premaxillae as in *Asellia* and *H. commersonii*; p^2 still with small cusp and retained in toothrow; m^3 less reduced than in *Asellia tridens*; toothrows almost parallel as in *H. muscinus*. Lower incisors, as in *H. muscinus*, scarcely at all imbricated; p_2 unreduced, its cingulum length actually greater than that of p_4 (0.9 : 0.8), but markedly compressed laterally (width, 0.5 to 0.6).

Tricuspidatus, placed by Dobson and by Peters in a special division of *Hipposideros*, betrays affinities with *Anthops*, *Asellia*, *Triaenops* and *Cloeotis* by the division of the upper edge of the noseleaf into three points. It appears nevertheless to represent a distinct line of development which may be distinguished as

ASELLISCUS NEW GENUS

GENOTYPE.—*Rhinolophus tricuspidatus* Temminck from Amboina.

DESCRIPTION.—A *Hipposiderine* genus of bats with upper margin of transverse noseleaf divided into three points, no papilla on the sella, two lateral leaflets margining horseshoe, no frontal sac in either sex, tail extending considerably beyond membrane, as in *Asellia*.

Skull with large separate rostral inflations, premaxillary bones divergent in front, cochlea rather large.

Teeth. Incisors bilobed, small, divergent; canine with low posterior cusp; p^2 included in toothrow; m^3 scarcely reduced; p_2 low, uncrowded, laterally compressed. Toothrows parallel.

It seems probable that *stoliczkanus*¹ and

¹ Since this manuscript was completed a small series of "*Asellia*" *wheeleri* Osgood from Chipwi, northern Burma, has been examined. The species is a little smaller than *tricuspidatus*, with forearm, 49 mm., instead of 54; the ear less elongated and more like the ear in the *H. galeritus* group; the tail elongate instead of short (40 mm. : 25 mm.) and its tip extends two or three millimeters beyond the membrane.

The noseleaf, surrounded by rather dense facial hair, somewhat as in *Coelops*, is very like that of *tricuspidatus*, with three small points on the transverse leaf, which terminate three supporting ribs or septa. There are two lateral leaflets. The front of the horseshoe shows indications of a cleft. No frontal sac is present in the male. *Wheeleri* and *stoliczkanus* appear closely related.

The skull is slightly reminiscent of the skull of *Coelops*, in that it is low, and the canine-bearing portion and premaxillae are elongated; while the canines are strongly proodont, though devoid of the strongly developed supplemental cusps of *Coelops*.

The skull represents a quite advanced *Hipposiderine* near *Aselliscus*; the premaxillae though longer preserve the same relations with the upper incisors,

trifida Peters from the Malay and Burma region must also be referred to *Aselliscus*.

The new genus is distinguished from *Anthops* and *Trienops* by its very different premaxillae, zygoma and upper incisors, from *Cloeotis* by its relatively low jugal eminence and much deeper skull, from *Asellia* (*tridens*) by its lower sagittal crest, much inflated rostrum, pore-like infraorbital foramen and parallel toothrows, and from *Rhinonycteris* by the several characters given for the last by Dobson (1878).

The geographical range of *A. tricuspidatus* includes Amboina, Buru (Dammerman), the north coast of Dutch New Guinea, Batjan (Peters), Duke-of-York Island (Dobson), Morty Island, New Britain, and New Ireland (Dobson), Kei (Peters and Doria), Aola, Guadalcanar (Thomas), Woodlark Island (Thomas), Trobriand Island (Heller), Solomon Island and Santa Cruz Island (Sanborn).

RHINONYCTERIS GRAY

Rhinomycteris GRAY, 1847, Proc. Zool. Soc., London, p. 16.

Rhinonycteris GRAY, 1866, Proc. Zool. Soc., London, p. 81.

GENOTYPE.—*Rhinolophus aurantius* Gray, from North Australia.

Rhinonycteris is unrepresented in our collection. Study of the illustration of the noseleaves shown by Dobson, 1878 (Pl. VIII, fig. 2), shows a few cellular structures lateral to the transverse leaf, development of the anterior process of the internasal septum and a medial pit in front of the transverse leaf, much like those of the *Trienops*. But the transverse leaf is simple and rounded above, slightly pointed at the middle. There appears to be a median papilla on the "sella." The horse-

which are similarly delicate in structure; the molar series are parallel; p^1 is similar in size, shape and position; m^1 has the W-pattern similarly unmodified. It differs in possessing a quite large posterior zygomatic eminence somewhat as in *Trienops*, *Asellia* and *Cloeotis* and in the reduced, compressed form of p^2 .

From *Trienops* it is distinguished by its much narrower rostrum in proportion to braincase and in other characters (see *T. persicus* beyond). From *Cloeotis* and *Asellia* (both described beyond) it exhibits a number of distinguishing characters. Perhaps it should be accorded generic separation.

The status of *stolicakanus* Dobson can be cleared up only by restudy of the type. Dobson's illustration (1878, pl. 8), of the face of *stolicakanus*, which may be poorly drawn, seems to differ from *wheeleri* in several particulars.

shoe is broadened to form two angled expansions. The ears are simple, somewhat acute and appear to be slightly emarginate.

Canine with large secondary cusp, and peculiarities of premaxillae, rostrum, zygoma and sagittal crest (Miller, 1907).

R. aurantius is found chiefly in northern and northwestern Australia. Wood-Jones writes that it occurs rarely in South Australia.

TRIAENOPS DOBSON

Trienops DOBSON, 1871, J. Asiatic Soc. Bengal, XL, 2, p. 455.

GENOTYPE.—*Trienops persicus* Dobson, from Shiraz, Persia.

Additional forms named:

<i>afer</i> Peters	Mombasa
<i>furcula</i> Trouessart	W. Madagascar
<i>humbloti</i> Milne Edwards	E. Madagascar
<i>rufus</i> Milne Edwards	E. Madagascar
<i>aurita</i> Grandidier	Diego Suarez
<i>furinea</i> Trouessart	Aldabra Islands
<i>?wheeleri</i> Osgood	Tonkin

With the exception of *wheeleri* Osgood,¹ already dealt with under *Aselliscus*, this genus is indigenous to the part of the world which includes Persia, Arabia, East Africa and the Mascarene group of islands.

Trienops persicus Dobson

U.S.N.M. 123439, Arabia.

Ears short, acute, very like the emarginate ear in the *galeritus* group, but with a well-developed fold at anterior edge, also a low tragus inside antitragal lobe. Horseshoe not cleft, but interrupted by flat rectangular process from internasal septum. Supplemental leaflets two, the inner interrupted at each side near front, and its anterior parts uniting smoothly in advance of horseshoe. The posterior half divides and anastomoses to form a complex system of six cells between the eye, the horseshoe and the transverse leaf. The outer leaflet small and broad. The transverse leaf modified into three high, pointed processes, much as in *Cloeotis*. In front of the central one of the processes a large median pit, and in front of the pit the "sella," upon which stands a high, pointed, laterally compressed papilla, the

¹ 1932, Mammals of the Kelly-Roosevelt Expedition, p. 224.

equivalent of similar organs in *Cloeotis* and *H. muscinus*.

Skull rather high and with high rostrum, canine-bearing part extended forwards (as in *H. pratti*); rostrum broad, the swellings individual and their inflations in the frontal rather than in the maxillary portion of the rostrum; jugal eminence very large and high, occupying almost the whole length of the zygoma; squamosal roots of zygomata little expanded; premaxillae indistinct (not described); roofs of pterygoid and nasal canals with step-like discontinuity as in *H. armiger*; cochlea rather large; a foramen developed in the web of bone tying together the angular and articular processes of mandible.

Outer lobe of upper incisor well developed, and teeth convergent, approximated, placed towards center of combined premaxillae; canine with definite posterior cusp to half its length; p^2 excluded, not extremely reduced; m^1-3 with W-pattern only slightly reduced. Outer of three lobes of outer lower incisor obsolescent; p_2 low but cingulum length not reduced.

CLOEOTIS THOMAS

Cloeotis THOMAS, 1901, Ann. Mag. Nat. Hist., (7) VIII, p. 28.

GENOTYPE.—*Cloeotis percivali* Thomas from British East Africa.

Additional form since named: *australis* Roberts.

Cloeotis percivali Thomas

U.S.N.M. 154589, Rhodesia, South Africa.

A very small bat with forearm 34 mm. Ears short, low, rounded, only the suspicion of a "tip" perceivable. Horseshoe deeply cleft in front, the two sides of the cleft raised and produced as two small processes. Two lateral leaflets, the outer larger, coalesce upwards to form a single fold which reaches the side of the transverse leaf. Transverse leaf modified into three high pointed processes which rise from the three septa. Transverse leaf subtended on each side by large lateral papilla, which low cutaneous ridges connect with inner canthus of eye and with transverse leaf. Sella with small clubbed process at center

and between center and outer margin a small eminence (on each side). Thumbs quite small. Frontal sac? Tail not reduced (7 joints).

Skull short, low, broad (like *Hipposideros dyacorum*). Rostral swellings moderate, rostrum low; intertemporal constriction marked; premaxillae not clearly visible; palate to half m^2-2 only, with a broad spine; zygomata wide, jugal eminences, contrary to Thomas' description large, and unlike those of *Asellia*, inclined backwards, limited to portion of zygoma directly over glenoid; glenoid surfaces broad and flat; Eustachian tubes well developed; cochlear spirals visible (large); tympanic rings not enlarged; angular processes connected by web of bone with articular; coronoid low.

Upper incisors two-lobed but very small, the roots above the crowns very slender as in *Aselliscus*; c with posterior cusp descending for half its length; p^2 greatly reduced, excluded; p^4 well developed; hypocones weak, internal interdental spaces large; m^3 with W-pattern almost complete. P_2 not much reduced, low, but its cingulum length not shortened.

ASELLIA GRAY

Asellia GRAY, 1838, Mag. Zool. Bot., II, p. 493; 1843, List Spec. Mamm. British Mus., p. 24; 1866, Proc. Zool. Soc. London, p. 81.

GENOTYPE.—*Rhinolophus tridens* Geoffroy (by monotypy) from Egypt.

Additional forms since described:

<i>murraiana</i> J. Anderson	Karachi, India
<i>patrizii</i> de Beaux	Ethiopia
<i>italosomalia</i> de Beaux	Italian Somaliland
<i>pallida</i> Laurent	French Morocco
<i>diluta</i> Andersen	Algerian Sahara

Asellia, excluding *tricuspidata* and its allies for which the genus *Aselliscus* has now been proposed, is seen to range across arid northern Africa, Arabia and Iraq to northwest India.

Below is a redescription of *A. tridens murraiana* J. Anderson, 1881, based upon material at the Field Museum of Natural History.

Asellia tridens murraiana J. Anderson

F.M.N.H. 48728, ♂, Baghdad.

Ears much like *H. speoris*, with anti-tragal notch and groove, no tragus, outer

edge emarginate, no costal fold as *Tri-aenops*.

Horseshoe weakly notched in front, no trace of process from internarial region; lateral leaflets two, the inner smaller; transverse leaf with three processes, the median high and narrow, the lateral ones nearly as high but much broader; no papilla on sella (see *Tri-aenops*, *Cloeotis*, and *H. muscalis* and *cyclops*), no complex of cells lateral to noseleaves (*Tri-aenops*). Tail extending considerably (one joint) beyond uropatagium.

Skull with well-expanded zygomata, jugal eminence not enlarged as in *Tri-aenops*, rostrum wide and almost as high as braincase without sagittal crest; premaxillae strongly fused, rounded posteriorly at contact with palate, their lateral processes nearly contiguous with maxilla and not enclosing incisive foramina; back of palate level with backs of m^3 - 3 ; cochlea more than twice as wide as their distance apart (2.8 : 1.0).

Upper incisors peg-like (outer lobe obsolete), divergent, placed at outer corners of premaxillae; canine with posterior cusps descending below middle of tooth, much as *Tri-aenops*; absolutely no indication of p^2 ; p^4 large; interdental spaces somewhat reduced; m^3 with much reduced W-pattern; outer lower incisor considerably thicker than the inner, the outer lobe unreduced (compare *Tri-aenops*). Anterior lower premolar considerably reduced, and moved slightly outwards in the toothrow.

COELOPS BLYTH

Coelops BLYTH, 1848, J. Asiatic Soc. Bengal, XVII, 1, p. 251.

Chilophylla MILLER, 1911, Proc. U. S. Nat. Mus., XXXVIII, p. 395.

GENOTYPES.—*Coelops*, *frithii* Blyth from "Soonderbuns" = Sandarbans (Dobson), Bengal; *Chilophylla*, *hirsuta* Miller from Mindoro.

The following further systematic work on *Coelops* has been done:

- 1862, PETERS, Archiv f. Naturg., II, p. 117.
1865, PETERS, Monatsber. Akad. Berlin, pp. 641-648, described *C. bernsteini*.
1871, PETERS, op. cit., pp. 330-332, reviewed the genus, synonymizing his own species.

- 1878, DOBSON, Cat. Mamm. Brit. Mus., pp. 152-153, reviewed *Coelops*.
1907, MILLER, Bull. U. S. Nat. Mus., LVII, pp. 113-114, reviewed *Coelops*.
1908, BONHOTE, J. Fed. Malay States Mus., III, p. 4, described *C. robinsoni* from Pahang.
1911, MILLER, loc. cit., described *Chilophylla hirsuta* from Philippines.
1912, MILLER, P. Biol. Soc. Wash., XXV, p. 117, remarked on dentition and skull of "*Chilophylla hirsutum*," not from Philippines but from Federated Malay States (thus probably *C. robinsoni*).
1928, HORIKAWA, Trans. Nat. Hist. Soc. Formosa, XVIII, No. 98, described *C. formosanus*.
1928, G. M. ALLEN, Amer. Mus. Novit., No. 317, p. 4, described *C. sinicus* from Szechwan.
1928, MILLER, P. Biol. Soc. Wash., XLI, p. 85, synonymized his *Chilophylla* with *Coelops* (in footnote) and described as new *C. inflata* from Fukien.
1929, OSGOOD, Field Mus. N. H., Zool., XVIII, pp. 226-228, discussed the genus. He indicated the supplementary canine cusps.

The named forms of *Coelops* may be listed as follows:

<i>frithii</i> Blyth	Bengal
<i>bernsteini</i> Peters	Java
<i>robinsoni</i> Bonhote	Pahang, Malay
<i>inflata</i> Miller	Fukien
<i>sinicus</i> G. M. Allen	Szechwan
<i>formosanus</i> Horikawa	Formosa
<i>hirsuta</i> Miller	Philippines

The following remarks on *Coelops* are based upon examination of *Coelops* "*robinsoni*," U.S.N.M. 175000, Malay States.

Coelops represents a type of bat very different from the Hipposiderine genera previously described. Horseshoe, if it may be so called, with deep anterior median notch reaching back to the internasal septum, each lateral portion of horseshoe parted into two greatly overlapped lobes, the outer over the inner, the inner extended farther forwards than the outer one. Lateral leaflets apparently absent, or else obscured by a dense development of stiff hairs which margin the nasal area. Transverse leaf rather low, posteriorly pocketed, with, however, a small median eminence. "Sella" with slight median raised ridge connecting internasal area with middle of transverse leaf. No visible frontal sac (Dobson says it is present). Ear short, rounded, with antitragal lobe, devoid of strengthening "ribs" as in

Hipposideros, etc. Thumb with metacarpal extraordinarily lengthened, its length to that of basal phalanx = 5.7 : 1.2. Tail extremely short, if not absent. Calcar much shortened, its length to that of tibia = 3 : 15 mm.

The skull is correspondingly peculiar: braincase short and rounded; intertemporal region narrow; rostral area with inflations confined to maxillary portion, the nasal portion uninflated, flat; zygomata short, little expanded, without jugal eminence; infraorbital foramen a pore, not enclosed by a bar, as in most *Hipposideros*; tooth-bearing portion of maxilla greatly extended forwards, carrying the tooththrow with it so that the back of the premaxillae is level with the middle of m^2 ; premaxillae correspondingly extended to allow the incisors to be in line with the fronts of the proödont canines; back of palate slightly behind m^3 ; cochlea and tympanics not modified; but basicranial foramina enormously enlarged. Mandibles, with toothrows parallel, U-shaped at symphysis.

Upper incisors minute, convergent, the outer lobe obsolescent; canine highly proödont, provided with two accessory cingulum cusps, each of which extends more than halfway down the body of the tooth; the posterior cusp, common to many *Hipposiderinae* and *Megadermidae*, and an internal cusp; p^2 small but still with cusp, retained in tooththrow; p^4 rather weaker than in most *Hipposiderinae*; m^3 with W-pattern virtually complete; lower incisors not imbricated, retaining all three cusps; lower canines small, vertical; p_2 unreduced, compressed, somewhat as in *tricuspidata*, moved slightly outwards in tooththrow.

The skull of this specimen was used in 1912 by Miller to describe the "cranial and dental characters of *Chilophylla*" and again by Taylor¹ for the same purpose.

Besides the skull of "*robinsoni*" just mentioned, I have before me for study the type skull of *sinicus*, two specimens from Tonkin marked *inflata* (F.M. 32232-3), and five from Bali (A.M.N.H. 107508-12); and in addition photographs of the skulls of the types of *bernsteini* and *robinsoni*.

C. robinsoni with forearm 37 mm. was stated by Bonhote to be the smallest of the genus. The forearm of U.S.N.M. 175000 is said by Taylor to measure only 33.5. The skull of this specimen differs sharply from all others seen not only in its small size but in the obsolescence of the customary large pocket or recess inside the maxillary root of the zygoma, anterior to the temporal fossa and directly above the roots of m^4 and the posterior half of m^3 . This pocket in U.S.N.M. 175000 (*robinsoni*?) is reduced to a small pore. Further, the upper edge of the zygoma terminates abruptly on meeting the rostrum level with the back of m^4 , while in other species examined the zygomatic edge runs upwards and forwards onto the rostrum to terminate almost level with the back of m^1 .

Again, the pterygoids are placed much nearer the back of the palate than in any other form examined: in "*robinsoni*" the distance from back of palate to back of hamulus of pterygoid = 1 mm., and in others the distance is 1.5 mm. or greater.

C. inflata was compared chiefly with *robinsoni*. It and *bernsteini* of Java appear to be related; the forearm length in each is 35.5. The tooththrow of *bernsteini*, measured against a millimeter rule photographed with the type skull, amounts to 6.1 mm.; that of *robinsoni*, obtained in the same way, to 4.9 mm. Also it can be seen clearly that the zygoma does not merge with the rostrum as described above for *robinsoni*. Our series from Bali is apparently near *bernsteini*: tooththrow, 5.6-5.8 mm.; forearm, 38, and greatest width of braincase, 7.6. In *sinicus* the tooththrow, $c-m^3$ attains 6.2 mm.; the forearm, 36; width of braincase, 8.0.

The relationship of *frithii* from Bengal and *hirsuta* from the Philippines to the Indo-China and Javanese forms can be cleared up only when the type of the former has been re-examined and topotypes of the latter secured and studied. *Formosanus* is probably close to *inflata* or *sinicus*.

It has long been customary to place *C. bernsteini* of Java in the synonymy of *C. frithii* of Bengal. But considering the

¹ 1934, Taylor, "Philippine Land Mammals," pp. 247-248.

new forms which have been distinguished in the Malay region, China and Philippines, I doubt whether the practice should be longer held to, at least until the synonymy can be re-established by direct comparison of topotypes of each. Therefore the name *bernsteini* is here revived and applied to the Archbold series from Bali, just east of Java.

NYCTERIDAE

NYCTERIS GEOFFROY

Nycteris GEOFFROY, 1803, Cat. Mammi. Mus. Nat. Hist., p. 64.

Petalia GRAY, 1838, Mag. Zool. Bot., II, p. 484.

Petalia GRAY, 1866, Proc. Zool. Soc. London, p. 83.

Nycterops GRAY, 1866, Proc. Zool. Soc. London, p. 83.

GENOTYPES.—*Nycteris*, *Vespertilio hispidus* Schreber, Africa. *Petalia* (*Petalia*), *Nycteris javanica* Geoffroy, Java. *Nycterops*, *Nycterops pilosa* Gray, Africa.

When Gray set up *Nycterops* and further characterized "*Petalia*," he exemplified *Nycteris* Geoffroy by *N. thebaica* instead of *N. hispidus*. Allen¹ shows *hispidus* from Senegal and *thebaica* from Egypt as distinct species. He lists a total of 22 full species from Africa. Only *javanica* and *tragata* are recorded from the Orient. So *Nycteris* is to be regarded as primarily African with a subgeneric offshoot (*Petalia*) in the East Indies.

Although in some African species, for example, *arge*, *hispidus*, *major*, considerable further reduction of the posterior lower premolar is attained, and in *major* it becomes vestigial, neither of the Javanese species shows this modification.

Nycteris was reviewed by Peters² and by Dobson.³ Peters appended an excellent plate to his paper, showing lower jaws and the condition of the lower teeth in eight species. Reduction and displacement of the posterior lower molar are clearly seen in many of them. He classified the species by their ears, the cusps of the incisors, the state of p_1 . His system resulted

in the association of *grandis* from Guinea (West Africa) and *javanica*.

Dobson made his first division on characters of the tragus and his subsidiary ones on the structure of incisors, ears and lower premolars. His plan brought *Javanica* closest to *aethiopica* and next to *grandis*.

N. tragatus Andersen, 1912, differs from *javanica* chiefly by characters of the tragus and greater size of the teeth. The fourth premolar is similarly unreduced. The East Indian species compared with most African are unspecialized *Nycteris* with scarcely reduced p_1 , and unenlarged ears. They are specialized, in that the outer lobes of the originally trifold lower incisors are obsolete.

Our collections contain both *javanica* and *tragata*, the latter represented by two specimens from Macarah Doewa, Palembang, Sumatra. The conspicuously larger teeth ($c-m^3$, 8.9 and 8.8 mm.) and p_1 even less reduced in proportion to p_2 , and the slightly larger palate and rostrum distinguish *tragata* from *javanica*, in addition to other features published by Andersen. We have photographs of the skull of *N. tragata*.

MEGADERMIDAE

MEGADERMA GEOFFROY

Megaderma GEOFFROY, 1810, Ann. Mus. Hist. Nat. Paris, XV, p. 197.

Spasma GRAY, 1860, Proc. Zool. Soc. London, p. 83.

GENOTYPES.—*Megaderma*, *Vespertilio spasma* Linnaeus. *Spasma*, *Vespertilio spasma* Linnaeus.

Megaderma and allied genera have been reviewed repeatedly. Probably the clearest way to present the taxonomic work done on the genera is to trace it chronologically:

1838, GRAY, Mag. Zool. Bot., II, pp. 490-491, proposed *Lavia*, with type *M. frons* Geoffroy.

1847, HODGSON, S. Asiatic Soc. Bengal, XVI, p. 891, proposed *Eucheira* for *M. lyra* Geoffroy. As shown later by Miller (1907) this is a homonym of *Eucheira* Westwood, 1836, Trans. Entom. Soc. London, I, p. 44.

1872, PETERS, Monatsber. Akad. Wiss. Berlin, pp. 192-196, reviewed *Megaderma*, described *M. cor.* and erected *Lyroderma* for *M. lyra*.

¹ 1939, Bull. Mus. Comp. Zool., LXXXIII, pp. 67-71.

² 1870, Monatsber. Akad. Wissen. Berlin, pp. 900-914.

³ 1878, Cat. Chir. Brit. Mus., pp. 161-167.

- 1873, PETERS, *op. cit.*, p. 488, proposed *Cardioderma* for *cor*.
- 1878, DOBSON, Coll. Chirop. Brit. Mus., pp. 154-160, treated all foregoing names as subgenera of *Megaderma*.
- 1880, DOBSON, Proc. Zool. Soc. London, p. 461, described *M. gigas*.
- 1906, MILLER, Proc. Biol. Soc. Wash., XIX, p. 84, proposed *Macroderma* for *Megaderma gigas*.
- 1907, ANDERSEN AND WROUGHTON, Ann. Mag. Nat. Hist., (7) XIX, pp. 129-145, reviewed the family Megadermidae, proposing several new species and races. They attempted to revive *Eucheira* and discussed the wing structure and general relationships of the genera.
- 1907, MILLER, Bull. U. S. Nat. Mus., Wash., LVII, pp. 101-106, recognized the genera *Megaderma*, *Lyroderma*, *Macroderma*, *Lavia* and *Cardioderma*. He showed *Eucheira* Hodgson to be a homonym.
- medius* Andersen Singapore
majus Andersen Lower Chindwin
minus Andersen Cambodia
ceylonense Andersen Trincomalee, Ceylon
- Lyroderma*
lyra Geoffroy "probably E. coast of Madras"
caurina Andersen Surat, India
and Wroughton
sinense Andersen and Wroughton Amoy, China
canonica Elliot S. Martha Country
schistacea Hodgson N. E. Bengal
spectrum Wagner ? Kashmir

We have photographs of the type skulls of *Megaderma natuna*, *majus*, *medium minus*, *pangandarana* and of *Lyroderma sinense* and *caurina*.

Our material from Celebes appears inseparable from our series from Cheribon, Java. In *pangandarana* Sody seems to have named a series of bats which average very slightly larger than usual. And in spite of the extraordinary differences Geoffroy¹ has shown in their nasal leaves, it remains questionable whether *trifolium* of Java is significantly different from *spasma*. Topotypes from Ternate, type locality of *spasma*, are needed. *Spasma* was founded upon a figure in Seba.

On the other hand, a specimen from Burma, A.M.N.H. 54815, referable to *majus*, has decidedly larger molar teeth (c-m³, 10.3; m¹⁻³, 5.9 mm.), compared with 9.1 and 5.2 in Cheribon (Java) material.

Since that time the generic situation has remained static.

The named forms of the Oriental subgenera *Megaderma* and *Lyrodermu* are shown in the accompanying list:

<i>Megaderma</i>	
<i>spasma</i> Linnaeus	Ternate Island
<i>trifolium</i> Geoffroy	Java
<i>carinatae</i> Miller	Karimata Island
<i>natunae</i> Andersen	Natuna Island
and Wroughton	
<i>philippinense</i> Water-	Philippines
town	
<i>horsfieldi</i> Blyth	"Continental India"
<i>lasiae</i> Lyon	Lasia Island
<i>niasense</i> Lyon	Nias Island
<i>siumatis</i> Lyon	Siumat Island
<i>pangandarana</i> Sody	S. Central Java

ON THE INTER-RELATIONSHIPS OF THE LEAF-NOSED BATS

The affinity of *Anthops*, *Aselliscus*, *Rhinomycteris*, *Triaenops*, *Cloeotis*, *Asellia* and *Coelops* to *Hipposideros* rather than to *Rhinolophus* is indicated chiefly by reduction of their pedal phalanges to two and by lack of p₃. Further they are well differentiated from the megadermid and nycterid bats.

In the Megadermidae and Nycteridae a tendency for the ears to become enlarged and united is developed. Various types of nasal appendages are seen. The tragus is present, bifid. *Megaderma*, *Lavia* and *Lyroderma* resemble *Rhinolophus* in possessing high posterior noseleaves, but in

Nycteris the posterior leaf is so much reduced as to be rudimentary. A true horse-shoe, with broadened, shield-like internarial septum appears in *Lyroderma* and *Megaderma spasma*, but in *Lavia* there is no internarial development. The number of phalanges of the toes is complete in all. None shows the special modifications of the thumb to be seen in *Coelops*.

In its skull, *Nycteris* alone has developed the extreme shortening of the palate common in *Rhinolophus*, but this condition cannot show relationship, since the pre-

¹ 1810, Ann. Mus. Hist. Nat. Paris, XV, pp. 187-198.

maxillae and rostrum are formed in wholly different ways. Two pairs of bifid upper incisors and three of trifid lower incisors can be seen. In the mandible of *N. revollii* p_3 , very minute, is found beneath the outside of the adjoining cingula of p_2 and p_4 , but p_3 is absent from *N. javanica* and *arge*. The angular process of the mandible is much reduced, a unique character among the bats being discussed.

Megaderma and *Lyroderma* should perhaps not be separated more than subgenerically. Tragus very large (as in *Lavia*; in *Nycteris* quite small); tail obsolescent (also in *Lavia*, but well developed in *Nycteris*). Skull in many ways unspecialized—e.g., palate, *basis cranii*, rostral region—but premaxillae apparently never ossified and upper incisors entirely wanting. Canine possessing the large, posterior cusp, so frequent among *Hipposiderinae*; p^3 minute, inside c and p^4 ; W-pattern of m^3 much reduced; lower incisors (3-lobed) two; p^3 absent, p^2 unreduced.

Lavia has developed expanded post and anteorbital processes and a low rostral region, similar to the depressed frontal area of *Nycteris*. But, like *Megaderma*, it has lost the premaxillae and upper incisors. Posterior canine cusp large; p^2 obsolete; m^3 much reduced; lower incisors two; p obsolete. The angular processes are unreduced in *Lavia*, *Megaderma* and *Lyroderma*.

As was pointed out under *Hipposideros* the lines of development of the several structures usually employed in classification of the leaf-nosed bats seem to function and change independently. Some of these structures are traced below, as they appear in some genera of the *Nycteridae*, *Megadermidae* and *Rhinolophidae*.

The transverse noseleaf is seen in very simple form in *Nycteris* and in the *bicolor* and *calcaratus* groups of *Hipposideros*. In *Hipposideros* it is primarily a flat, rounded structure with three "septa" supporting it in front. In the *H. diadema*, *armiger* and *pratti* groups it becomes lobed and enlarged. In *Anthops* the lobes are further developed, the apex of each lobe being also the termination of a correspond-

ing "septum." The noseleaf of *Asellia* is somewhat similar.

At this stage one of two courses is followed: the three lobed or raised parts of the leaf become higher and acutely pointed as with *Cloetis* and *Trienops*; or else, the median one only of the three becomes enormously enlarged while the lateral ones degenerate, as in *Rhinolophus* and the *Megadermid* bats. Contrary to all of the foregoing, the transverse noseleaf of *Coelops* develops twin points instead of one or three.

In conjunction with the transverse noseleaf special cells or pockets develop: the median, anterior pouch and the honeycomb of lateral pits found in *Rhinonycteris* and *Trienops*; the frontal sac in *Hipposideros*.

The ear develops along two wholly different lines of specialization. In the *Megadermidae* and in *Hipposideros megalotis* the ears become enlarged and united across the forehead by a common fold of skin. But also in the *Megadermidae* the large bifid tragus is retained, whereas in the *Hipposiderinae* it becomes obsolete. Folds strengthening the pinna of the ear, which appear in all genera with large ears, are non-existent in *Coelops*. In it the ears are small, rounded and uniform in structure. They are commonly described as "funnel-shaped."

The rostral region of the skull remains broad, flat and relatively unspecialized in *Megaderma* and in the *Hipposideros armiger* group. In most of *Hipposideros* and allied genera and in *Rhinolophus* the rostrum is raised and variously inflated, the swelling affecting usually both nasal and maxillary portions. On the other hand, a marked dorsal depression or pit occupies the whole frontal area in *Nycteris* and *Lavia*. *Coelops* manifests a similarly depressed rostrum.

The premaxillae are in course of reduction by three methods. In *Megaderma* the premaxillary bones remain cartilaginous. In *Nycteris* the outer portions, each carrying two incisors, become ossified and more or less completely fused to the maxillae laterally. In all *Rhinolophidae* it is the center of the combined premaxillae which ossifies (bearing one incisor only on

each side), while the space laterally between maxillae and the palatal branch of premaxillae tends to remain open.

Of the upper premolars p^2 is rudimentary in all families except Nycteridae. It is obsolete in *Nycteris*, rudimentary and displaced inwards from the toothrow in *Hipposideros* and *Rhinolophus*. In the lower jaw of *Rhinolophus* p_3 , greatly reduced, is seen on the outer side of the ramus, displaced by the contiguous p_2 and p_4 . The tooth is absent in all other genera.

In most genera p_3 , although wholly different in shape from p_4 , due to its being single-rooted instead of double-rooted, is about as large as p_4 . It becomes slightly reduced in *Lavia*, *Rhinolophus*, *Triaenops*, *Asellia* and *Hipposideros*, and quite markedly so in *H. muscinus* and in *Clootis*. But in the exceptional case of *Nycteris* p_4 is absent, while p_2 takes its place as the large functioning premolar, with p_3 much or slightly reduced behind it (*N. javanica* and *arge*), or even vestigial and concealed beneath the cingulum of p_2 (*N. thebaica*).

The W-pattern of m^3 remains fairly complete in *Clootis*, *Coelops*, *Triaenops*, *Rhinolophus* and in *Hipposideros muscinus*. It is more or less reduced in the majority of *Hipposideros*, and in *Nycteris*, *Lavia*, *Megaderma*, *Asellia*.

Obviously most modifications in the six sets of structures just discussed are of ancient origin and have operated with varying intensities upon the species of the three families just discussed, which Weber¹ unites as the superfamily Rhinolophoidea. When character changes turn up indiscriminately through the three families and their genera, those same characters are unlikely to prove universally valuable as indicators of relationships. For example, because progressive reduction of the pattern of m^3 shows in all groups, the condition of the tooth is significant chiefly when the W-pattern is unreduced. But characters marking a distinct, irrefragable departure from type, which are confined to a small group of species, such as shows in the premolars of *Nycteris*, are of value. Neither the Nycteridae because of their

premaxillae and premolars, nor the Megadermidae because of their exaggerated transverse noseleaves and total obsolescence of premaxillary bones can show direct relationship to the hipposiderine genera. But they still exhibit a number of those character trends which were constantly in operation during the evolution of the superfamily taken as a whole. Enlargement of the rostrum,² non-ossification of the lateral connections of the premaxillae to the maxillae, the tendency for the ears to remain free, obsolescence of the tragus—these are characters of the Rhinolophidae which the Megadermidae and Nycteridae lack.

The single large genus *Rhinolophus*, commonly given subfamily rank, differs from the remainder chiefly by non-coalescence of the toes of the feet to make two joints instead of three (all Hipposiderinae); by the exaggerated development of the posterior noseleaf into a tall blade and the development of corresponding modifications of the "sella" region; and by the pronounced shortening of the palatal bridge. Further characters of *Rhinolophus*, which, however, are duplicated by other genera and by one or another of the species groups of *Hipposideros*, are: linear arrangement of the lower incisors (also in *H. muscinus* and *Coelops*), wide separation of the upper incisors (*H. commersonii*, *Asellia*, *Aselliscus*), large size and approximation of cochlea (*H. muscinus*). Thus some of the conspicuous features which distinguish certain Hipposiderine bats are "standard" characters in *Rhinolophus*.

Out of the large number of characters usable for defining a species only a very few are absolute characters of kind. The preponderance represent merely differences of degree which frequently fluctuate among the species composing the genera whose phylogeny one seeks to trace out. Although the fluctuating characters ought to carry much weight in estimating phylogenetic relationships it is the few absolute ones which in practice are seized upon. Because *Coelops* has but two joints to the toes of its hind feet it is placed with the

¹ 1927, "Die Säugetiere," I, p. xiv.

² In *Coelops*, incipient only.

Hipposiderinae. But apart from its specialized feet, it shows several quantitative characters and at least two qualitative—the depressed frons and the highly individual type of noseleaves—which suggest it may belong elsewhere and that the fusion of the tarsals indicates a case of convergence.

Coelops is, in fact, so remote from other hipposiderine bats that it may be desirable

to grant it subfamily rank, the *Coelopsinae*. Its unique characters are listed:

- 1.—Structureless condition of the ear pinna.
- 2.—Strongly differentiated "horseshoe."
- 3.—Enormously elongated first metacarpal.
- 4.—Absence of tail.
- 5.—Greatly extended canine-bearing portion of maxilla.
- 6.—Much fenestrated *basis cranii*.
- 7.—Internal as well as posterior supplemental canine cusps.
- 8.—U-shaped symphyseal portion of combined mandibles.

LEAF-NOSED BATS, OTHER THAN *RHINOLOPHUS* AND *HIPPOSIDEROS*, IN THE ARCHBOLD COLLECTIONS

NYCTERIDAE			
<i>Nycteris javanica</i>	Cheribon, Java		41
<i>Nycteris javanica</i>	Noesa Penida, Bali		18
<i>Nycteris tragata</i>	Macarah Doewa, Sumatra		2
MEGADERMIDAE			
<i>Megaderma spasma</i>	Cheribon, Java		6
<i>Megaderma spasma</i>	Taliaboe Island, Moluccas		2
<i>Megaderma spasma</i>	Togian Island, Celebes		1
<i>Megaderma spasma</i>	Wawo, S. Celebes		1
HIPPOSIDERINAE			
<i>Aselliscus tricuspidata</i>	Hollandia, Dutch New Guinea		44
COELOPINAE			
<i>Coelops</i>	Oeboed, Bali		5

Species occurring in the New Guinea-Australian region but not obtained by the Archbold expeditions are: *Anthops or-*

natus, *Rhinonycteris aurantia* and *Macroderma gigas*.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 37

NOTES ON ORIENTAL *TAPHOZOUS* AND ALLIES

By G. H. H. TATE

Eight forms including 76 specimens represent the *Taphozous* bats in the Archbold collections from the East Indies and Australia.

Originally all species were referred to *Taphozous* Geoffroy.¹ Subsequently *Saccolaimus* Temminck (= *Taphonycteris* Dobson) and *Liponycteris* Thomas were generically differentiated. For some time they have been treated as full genera, but because their affinities are so close, they ought probably to be considered subgenera of *Taphozous*. The taxonomic history of *Taphozous* follows.

Many years after Geoffroy's initial work, Temminck² reviewed the nine species known at his time. He employed (*loc. cit.*, p. 279) *Saccolaimus* (from the Kühl ms.) in the generic sense to indicate *T. saccolaimus*.

Dobson,³ ignoring the generic use of *Saccolaimus* by Temminck (*loc. cit.*) and by Lesson (1842), separated the *saccolaimus* division under the name *Taphonycteris*, with *T. saccolaimus* type and additional species *affinis* and *pelei*. But Miller⁴ later showed that *Taphonycteris* Dobson was a synonym. Hollister⁵ drew attention to the differentiation of the audital bullae in *Saccolaimus* and *Taphozous*, the latter having the bullae incomplete, or with internal fenestrae. Thomas⁶ emphasized the distinctness and proposed several new

species of *Taphozous*. Seven years later he⁷ confirmed his 1915 classification of *Taphozous* and *Saccolaimus* but separated the *nudiiventris* group from *Taphozous* under the name *Liponycteris*. Finally Troughton⁸ revised the Australian members of the two subgenera *Saccolaimus* and *Taphozous*. He traced the usage of *Saccolaimus* in the generic sense as from Temminck. Formerly it had been attributed to Lesson, 1842.

In 1937 I had the opportunity to examine a number of the types in Europe and to photograph their skulls. In the case of *Saccolaimus saccolaimus* the co-typical series at Leyden contains two species: true *S. saccolaimus* and *longimanus*, subspecies *kampeni*, a *Taphozous*, which Jentink⁹ had regarded as young specimens of *saccolaimus*. Of his series of mounted specimens "a-f" I saw "a-e." Specimens "a," "b" and "c" were true *saccolaimus*. Dr. Junge had the skull of specimen "a" extracted and cleaned for me. Observations and measurements were made upon it. Specimens "e" and "f" were not *saccolaimus* but, as already stated, *longimanus*. Specimen "a," skin and skull may be regarded as the "lectotype" (a single specimen chosen from the type series) of *Taphozous saccolaimus* Temminck.

Saccolaimus and *Taphozous* (excluding *Liponycteris*, chiefly of the arid tropics—Abyssinia and Eritrea to northwest India) have become specialized in divergent ways: In its skull characters *Saccolaimus*

¹ Geoffroy, 1813, *Descr. de l'Egypte*, II, p. 113.

² Temminck, 1841, *Monographies des Mammifères*, II, pp. 273-291.

³ Dobson, 1875, *Proc. Zool. Soc., London*, p. 548; 1878, *Cat. Chiropt. Brit. Mus.*, p. 388.

⁴ Miller, 1907, "Families and genera of bats," pp. 93-94.

⁵ Hollister, 1913, *Proc. U. S. Nat. Mus.*, XLVI, pp. 307-308.

⁶ Thomas, 1915, *Jour. Bombay N. H. Soc.*, XXIV, pp. 57-63.

⁷ Thomas, 1922, *Ann. Mag. Nat. Hist.*, (9) IX, pp. 266-267.

⁸ Troughton, 1925, *Records Australian Mus.*, XIV, No. 4, pp. 314-341.

⁹ Jentink, 1888, *Mus. d'Hist. Nat. des Pays-Bas*, XII, p. 198.

saccolaimus is more conservative than *Taphozous perforatus* (genotype of *Taphozous*); its audital bullae are entire, the *basis cranii* is but little fenestrated; the paroccipital processes are shorter; p^2 is relatively large and laterally uncompressed, the lower incisors and p_{2-4} are relatively heavy teeth. In *perforatus* the reverse is the case, p^2 , the lower incisors and lower premolars are compressed, and in addition the pterygoid hamuli are very long and delicate. Structures in which *saccolaimus* may be regarded as the more specialized of the two are the helmet-shaped posterior sagittal crest and the greatly enlarged sphenoidal pits¹ which in this species become recessed over the eustachian region.

In the skins, the throat pouch developed by *Saccolaimus* is a specialization, but, as it is connected with sex, appears to be somewhat variable in taxonomic usefulness. The accentuation of the bare areas on the legs and thighs is another mark of specialization. *Saccolaimus* is restricted to the Orient and Australia; *Taphozous* is present almost throughout the Old World tropics.

The oriental species referable to the subgeneric divisions may be listed as follows:

<i>Saccolaimus</i>	
<i>saccolaimus</i> Temminck	Java
<i>affinis</i> Dobson	Labuan
<i>flavimaculatus</i> Sody	E. Borneo
<i>flaviventris</i> Peters	Australia
= <i>hargravei</i> Ramsay	E. coast N. S. Wales
= <i>insignis</i> Leche	S. Australia
<i>mixtus</i> Troughton	Port Moresby, Papua
<i>nudidiviniatus</i> de Vis	Cardwell, Queensland
= <i>granti</i> Thomas	Mimika R., Dutch New Guinea
<i>pluto</i> Miller	Mindanao, Philippine
= <i>capito</i> (Hollister)	Catanduanes Is., Philippine
<i>crassus</i> Blyth	
<i>putcher</i> Dobson	
<i>Taphozous</i>	
<i>T. longimanus</i> Hardwicke	Calcutta
<i>T. l. bicolor</i> Temminck	Calcutta?
<i>T. l. fulvidus</i> Blyth	
<i>T. l. brevicaudatus</i> Blyth	
= <i>cantori</i> Blyth	
<i>T. l. kampenii</i> Jentink	Java

<i>T. l. leucopleurus</i> Dobson	Flores
<i>T. l. albiginnis</i> Thomas	Labuan, Borneo
<i>T. melanopogon</i> Temminck	Java
<i>T. m. fretensis</i> Thomas	Terutau Is., Straits of Malacca
<i>T. m. cavaticus</i> Hollister	Pedang, W. Sumatra
<i>T. m. philippinensis</i> Waterhouse	Philippines
<i>T. m. solifer</i> Hollister	Peking, China
<i>T. m. achates</i> Thomas	Savu Is., West of Timor
<i>T. theobaldi</i> Dobson	Tenasserim
<i>T. t. secatus</i> Thomas	Central Prov. India
<i>T. australis</i> Gould	Australia
= <i>fumosus</i> de Vis	
<i>T. georgianus</i> Thomas	King George Sound
<i>Liponycteris</i> (we merely list the Oriental members of this group of species)	
<i>nudiventris</i> Cretzschmar (genotype)	N. Africa
<i>kachhensis</i> Dobson	Kachh, N. W. India
<i>k. magnus</i> Wettstein	Basra
= <i>babylonicus</i> Thomas	Euphrates R.
<i>k. nudaster</i> Thomas	Mt. Popa, Burma

SUBGENUS SACCOLAIMUS TEMMINCK

Of the named forms listed we have photographs of the type of all the following: *saccolaimus*, *affinis*, *flavimaculatus*, *granti*.

With *Saccolaimus* (with entire bullae, uncompressed p^2 , as defined by Troughton) the following distinct cranial types can be observed:

- 1.—Sagittal crest high, and projecting helmet-like, backwards over supraoccipital; anterior half of zygoma relatively deep (1.5 mm. or more); basisphenoid pits recessed above their anterior margins. Pits large, their posterior margins only 2 mm. from median part of notch of foramen magnum in basioccipital. To this group are referable *saccolaimus*, *flavimaculatus*, *affinis*, *pluto* (= *capito*), and the Australian *nudidiviniatus* (= *granti*?).
- 2.—Sagittal crest low, scarcely projecting behind supraoccipital; anterior half of zygoma little deepened (less than 1.5 mm. except right at maxillary root); basisphenoid pits often recesses posteriorly—above the basioccipital. Pits smaller; 3 mm. from foramen magnum.

Only Australian-New Guinean bats are referable: *flaviventris*, and *mixtus*.

Saccolaimus saccolaimus (Temminck)

Taphozous saccolaimus TEMMINCK, 1841, Monogr. Mamm., II, pp. 285-286.

TYPE REGION.—Java.

MATERIAL EXAMINED.—The series of co-

¹ Sphenoidal pits are nevertheless characteristic of the family Emballonuridae.

typical specimens, Leyden, "a-c"¹ with photograph of skull "h,"² the last stated by Jentink to be that figured by Temminck. A series of 8 skins and skulls from Cheribon, N. coast of Java.

Saccolaimus affinis (Dobson)

Taphozous affinis DOBSON, 1875, Ann. Mag. Nat. Hist., (4) XVI, p. 232.

TYPE LOCALITY.—Labuan, Borneo.

MATERIAL EXAMINED.—Type of *affinis*, ♂, B.M. 74.10.26.2, skull photographed; a series of 6 from Sampit-Perit (Tjempaga), S. Borneo, collected by J. J. Menden.

At first sight the creamy white underparts and wing membranes of these bats set them off very sharply from the previous species. But actually it is not possible to show the smallest structural difference between this material from S. Borneo and *saccolaimus* from Cheribon, Sumatra. Even the scattering of small white spots in the dorsal pelage, perhaps resulting from attacks by parasites, is present. The gular sac in females appears to me exactly like that in *saccolaimus*.

Flavimaculatus Sody, whose type was studied in 1937, is very like true *saccolaimus* both in appearance and measurement. Its peculiarities of color, pointed out by the describer,³ form part of the problem of whitening of the underfur and wing membranes in the taphozine bats. White-winged forms turn up in relatively unrelated species, e.g., *affinis* in *saccolaimus*, *leucopleurus* in *longimanus*, and *leucopterus* among the South African representatives of the genus. *Phuto*, with synonym *capito*,⁴ from its published measurements, though rather smaller, must be very near *saccolaimus*.

The last of the "helmeted" forms is the Australian *nudicluniatus* de Vis, of which Troughton (*loc. cit.*) has published good photographs and of which we have one specimen. Our photograph of the type skull of *granti* (a female), synonymized by

Troughton with *nudicluniatus*, shows no "helmet." So perhaps the helmeted condition is more developed in males.

Saccolaimus, near *mixtus* Troughton

Saccolaimus mixtus TROUGHTON, 1925, Records Australian Mus., XIV, 4, pp. 322-325.

MATERIAL.—Adult male, Dogwa, Oriomo R., western division, Papua. From limestone cave.

This unique specimen agrees closely in its structure and measurements with *mixtus*, only differing in the color of the underparts. Our specimen has the underparts, but not the wings, a very pale grayish white, while the underparts of Troughton's species were "of a peculiar light shade of grayish buff-brown." Is it possible that the type of *mixtus*, which had been in alcohol since at least 1878, may be discolored? Our specimen is so light beneath as to be considered white-bellied like *affinis* and *flaviventris*.

Some measurements: forearm, 61 mm.; condylo-canine length, 61.5; zygomatic width, 14.1; interorbital width, 7.6; intertemporal width, 5.7; width braincase, 10.2; mastoid width, 12.3; length of basisphenoid pits, 3.3; c-m³, 9.7.

Saccolaimus flaviventris (Peters)

Taphozous flaviventris PETERS, 1867, Proc. Zool. Soc., London, p. 430.

MATERIAL.—A series of 6 females with skulls from Pentland, North Queensland.

All specimens are very dark fuscous brown, except one female in which there is an admixture of light brown. Underparts of all yellowish white to roots of hairs.

No throat pouch but the hairs there are very short. Forearms, 74-78 mm. Tooth-rows, c-m³, = 11 mm.

These specimens appear to be wholly typical of the species described by Peters.

A single male skin, without skull, from Malbon near Pentland is referred here. The dorsal color is as dark as the series above, but the ventral pelage is colored light mouse-gray. Forearm, 74 mm.

Saccolaimus nudicluniatus de Vis

Saccolaimus nudicluniatus DE VIS, 1905, Ann. Queensland Mus., No. 6, pp. 39-40.

¹ Jentink, 1887, Mus. d'Hist. Nat. des Pays-Bas, IX, p. 287.

² Jentink, 1888, Mus. d'Hist. Nat. des Pays-Bas, XII, p. 197.

³ 1931, Natuurk. Tijdschr. Ned. Indie, III, pp. 355-360.

⁴ See Lawrence, 1939, Bull. Mus. Comp. Zool., LXXXVI, p. 42.

Taphozous granti THOMAS, 1911, Ann. Mag. Nat. Hist., (8) VIII, pp. 378-379.

Saccolaimus nudidorsatus TROUGHTON, 1925, Records Australian Mus., pp. 325-328.

MATERIAL.—One specimen in alcohol, A.M.N.H. 66144, Babinda Creek, N. Queensland.

SUBGENUS TAPHOZOUS GEOFFROY

Of this group of taphozoine bats (with incomplete bullae) our collections include three forms from the Sunda region, whose skins are readily separable from all others while their skulls can be distinguished only with difficulty. They are a small white-winged form from S. Borneo, forearm, 54 mm., *albipinnis*; a small brown form, *kampenii*, with the nape straw-colored, forearm, 56 mm., from Bali; and true *melanopogon*, males with ample "black beard," forearm, 61 mm., from Bali. The first two, represented also by males, have well-developed throat pouches, *melanopogon*, of course, none.

Skull characters separating the three are extremely slight; the inferior margins of the orbits of the first two equal arcs of circles; that in *melanopogon* is flatter. The inferior anteorbital process of *melanopogon* projects strongly in front of the orbit, and its infraorbital foramen is much smaller than in the others (diameter, 0.6 mm.: 0.8-0.9 mm.). Its molars are very slightly heavier. The width of basioccipital, between cochleae is a little greater (2.1 mm.: 1.7-1.8).

It is almost impossible to separate the first two by means of skull characters alone. Possibly the well-developed post-orbital process on the zygoma in *kampenii* will suffice, but it is by no means obsolete in the white-winged form.

Taphozous longimanus kampenii Jentink

Taphozous kampenii JENTINK, 1907, Notes Leyden Mus., XXIX, pp. 65-67.

MATERIAL.—Photograph of the type, Leyden, No. 1563, specimen "a"; and a series of seven specimens from Oboed, Bali; one adult male (the only specimen to exhibit the straw-colored nape), 4 adult females (2 lack skulls); 1 young male, 1 young female.

The females lack the pouch, although its position in adults is marked by a bare area outlined by a U-shaped fringe of body-hairs. The young animals of both sexes are much darker—almost fuscous.

Skins "d" and "e" of the co-typical series of *S. saccolaimus* are referable here. The skull of "d" was cleaned for me in Leyden (its c-m³, only 8.4 mm.). Jentink¹ wrote of "individus, adultes et jeunes," but while the adults were true *saccolaimus*, the young were *kampenii*.

Jentink writes that the forearm of his male specimen from Batavia measures 57 mm. Our old male measures 57 mm., the females 55-57. The virtual impossibility of distinguishing between the skulls of these bats and those of *albipinnis*, and their decided similarity to the skulls of *melanopogon* have been mentioned.

Taphozous longimanus albipinnis Thomas

Taphozous longimanus albipinnis THOMAS, 1898, Ann. Mag. Nat. Hist., (7) II, p. 246.

MATERIAL.—Photograph of skull of type (collected by Everett in Labuan), B.M. 93.4.1.29, ♀, and two male specimens obtained by von Plessen in swamp forest at Sampit-Perit (Tjempaga), S. Borneo.

These individuals (forearms, 52, 54 mm.; Thomas gave 56 for the female type), though a shade smaller, agree closely with the original description as regards color, etc. Tooththrows, c-m³, 8.1, 8.2; in type, 8.5; in *leucopleurus* Dobson from Flores, 8.8.

Taphozous melanopogon Temminck

Taphozous melanopogon TEMMINCK, 1841 Monogr. Mannin., II, pp. 287-288.

MATERIAL.—Photograph of Leyden co-type skull "a," a series of 16 specimens from Noesa Penida, Tjimingan, Bali.

The series appears to be typical. The likeness of skulls of *melanopogon* to those of *longimanus* has been mentioned. Four of our specimens have the strongly developed black beard for which the species was named.

T. melanopogon is apparently very wide-

¹ Jentink, 1888, Mus. d'Hist. Nat. des Pays-Bas, XII, p. 198.

ranging. Phillips¹ records it in Ceylon and G. M. Allen² reports four from Yunnan. Allen (*loc. cit.*) regards *solifer* Hollister as a stray *philippinensis*, carried adventitiously to Peking.

Taphozous georgianus Thomas

Taphozous australis georgianus THOMAS, 1915, J. Bombay N. H. Soc., XXIV, p. 62.

Taphozous georgianus TROUGHTON, 1925, Records Australian Mus., pp. 336-339.

MATERIAL.—Photograph of the type B.M. 44.2.27.59; large series of 23 from Quamby of which 9 are males; 3 males, 1

¹ Phillips, 1935, Manual of the Ceylon, p. 143.

² Allen, 1938, Mammals of China and Mongolia, I, pp. 159-161.

female from Pentland, and three females from Albany Island, type locality of *australis*.

These specimens agree in all of the characters given by Troughton in his key, with *georgianus*. But the evident wide distribution of *georgianus* in Queensland seems to dispose of Troughton's idea (*loc. cit.*, p. 339) that *australis* and *georgianus* are geographically segregated. Incidentally, this supports his contention that the two are good species.

T. georgianus, lacking as it does all trace of gular pouch, may possibly be the representative in Australia of the *melanopogon* group of bats.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 38

MOLOSSID BATS OF THE ARCHBOLD COLLECTIONS

By G. H. H. TATE

The collections are singularly poor in bats of the family Molossidae, so much so that without borrowing extensively from other museums no attempt at a general résumé can be made. Of the half dozen Indo-Australian genera and thirty-odd named forms we can report on only three genera and four species.

CHEIROMELES HORSFIELD

Cheiromiles HORSFIELD, 1824, Zool. Res. Java, VIII.

GENOTYPE.—*C. torquatus* Horsfield from Java.

MATERIAL.—Photographs of specimen of *caudatus* (Leyden, skull "c"), and of the type of *jacobsoni*, B.M. 23.10.7.9 from Simalur Island; A.M.N.H. 103922 from northeast Borneo (♀).

Temminck¹ renamed Horsfield's identical specimen *Dysopes cheiropus*, and somewhat later,² returning to the name *caudatus*, made additional notes based upon several specimens obtained in Bantam, Java, by Kuhl, van Hasselt and Müller.

Other forms have since been named: *C. parvidens* Miller and Hollister from Middle Celebes, and *jacobsoni* Thomas from Lugu, Simalur Island, N. W. Sumatra. The genus is recorded also from Indo-China (Wagner, 1855) and Philippines (Taylor, 1934; Lawrence, 1939). Miss Lawrence believed the Philippine race more like *parvidens* than *torquatus*.

CHAEAREPHON DOBSON

Chaerephon DOBSON, 1874, J. Asiatic Soc. Bengal, XLIII, pt. 2, p. 144; 1878, Cat. Chiroptera Brit. Mus., pp. 431-432.

GENOTYPE.—*Molossus johorensis* Dobson.

Chaerephon was originally distinguished

from *Nyctinomus* as a subgenus solely by the deep band of skin uniting the ears and the resultant pocket formed behind it. No second specimen of *johorensis* was found until nearly thirty years later, when Andersen³ described a male in alcohol from N. W. Sumatra. He compared it with "*plicatus*" from Java, B.M. 46.4.21.21, finding the "upper incisors, upper and lower canines, upper premolars, and anterior lower premolar . . . in *johorensis* comparatively shorter or smaller . . ." Further details were given of the complex mechanism of the united ears and the cavity behind them. The premaxillae were described as complete, the incisive foramina small and rounded.

This feature of the premaxillae was used by Miller⁴ in his key to Molossid genera to distinguish *Chaerephon* from *Nyctinomus* (= *Tadarida*?), but the presence or absence of the palatal branch of the premaxillae appears not to be an absolute character but to vary with different species, particularly the African members. Miller added, "The character on which it [*Chaerephon*] is now based is wholly unrelated to that which Dobson originally assigned to the group."

Thomas⁵ suggested yet another basis for classification, namely, the degree of reduction of the upper third molar, with the premaxillae and basi-occipital pits as secondary characters. *Chaerephon* under his arrangement included only species with m³ relatively complete. Species included were *johorensis* and *plicatus*.

³ 1907, Ann. Mus. Civico, Stor. Nat. Genoa, (3) III, pp. 39-42.

⁴ 1907, "Families and genera of bats," p. 244.

⁵ 1913, J. Bombay Nat. Hist. Soc., XXII, pp. 89-91.

¹ 1827, Monographies de Mammalogie, I, pp. 218-223.

² 1838, op. cit., II, pp. 345-351.

Chaerephon plicatus tenuis (Horsfield)

Nyctinomus tenuis HORSFIELD, 1822, Zool. Res. Java, V.

TYPE REGION.—Java.

MATERIAL.—Photograph of type skull, B.M. 79.11.21.137, braincase badly broken. A series of 15 specimens from Cherihon, N. coast of Java, and 19 from Soka, Bali.

The type skull was extracted from the skin and cleaned in 1937. It has a low sagittal crest, small lacrimal processes. Upper incisors simple, nearly $1/2$ height of c ; p^4 $2/3$ height of c ; p^3 , which is included in toothrow, quite small, its crown $1/3$ height of p^4 ; p_4 $3/4$ height of lower c ; p_2 $2/3$ height of p_1 .

Ears just meeting on frons.

Measurements of type of *tenuis* Horsfield: forearm, 42.5 mm.; least intertemporal width, 3.5; breadth braincase, 8.2; breadth meso-pterygoid fossa, 2.3; width inside m^{1-3} , 2.8; $c-m^3$, 6.35; m^{1-3} , 4.1; crown of m^1 , 1.65×1.9 ; of m^2 , 1.5×1.9 ; of m^3 , 1.0×1.7 .

It remains an assumption that *tenuis* Horsfield is a subspecies of *plicatus* Buchanan-Hamilton. The illustrations published by those authors lend some support to that assumption. But the type skull of the latter, presumed to exist in the India Museum (Dobson, 1879, p. 425, had seen it), should be studied.

Dysopes tenuis Temminck, contrary to his belief, was not equal to *tenuis* Horsfield. It was a decidedly different species, as shown by the skull, of which I have a photograph. Fortunately, Temminck in a footnote¹ provided a specific name, *labiatus*, for his "grand quantité d'individus." In 1838, Temminck² admitted the presence of a second larger species of Molossid in Java, to which he applied Horsfield's name *dilatatus*. The forearm was about 47 mm.

The following are notes taken from a co-type of *labiatus*, specimen "d," adult ♀, of Jentink's catalogue, whose skull was extracted and cleaned for me by Dr. Junge in 1937. Jentink remarked (*loc.*

cit.) "un des types des *Dysopes tenuis* Temminck. Java. Des collections des M. M. Kuhl et van Hassalt."

I quote notes made in Leyden: "A comparatively large species, with ears broad, convolute, meeting over frons. Skull well ossified; lower part of braincase missing; upper incisors close together, 1 mm. from $c-c$; upper premolars ONE EACH SIDE (perhaps related to *Mops* and *Philippinopterus*); lower incisors two each side, bifid; lower premolars two each side, p_2 slightly lower than p_1 ."

Measurements of co-type "d" of *labiatus*: forearm, 48 mm., total length of skull, 21.9; zygomatic width, 13.4; least intertemporal width, 4.6; breadth of braincase, 10.6; breadth of mesopterygoid fossa, 3.2; $c-m^3$, 7.7; m^{1-3} , 5.05; crown of m^1 , 2.15×2.15 ; of m^2 , 2.25×2.25 ; of m^3 , 1.3×1.95 .

Sody has recently described a race *adustus* (type, Sody, Pang. 70, of which I have a photograph) from Java, and he has revived the hopelessly unidentifiable name *dilatatus* Horsfield.⁴ Actually his large race (with forearm, "43-50") which he calls *dilatatus* may equal *labiatus*. His small race (forearm, "40-45") equals true *tenuis*. To his mid-sized race (forearm, 44-47) he had applied the name *adustus*.

Chaerephon plicatus colonicus Thomas

Nyctinomus plicatus colonicus THOMAS, 1906, Proc. Zool. Soc. London, II, p. 537.

TYPE LOCALITY.—Alexandria, North Australia.

MATERIAL.—Photograph of the type skull, B.M. 6.3.9.16; a series of 7 specimens from Malbon, Queensland, and an individual without skull from Pentland.

Thomas published most of the standard measurements of the type specimen, to which I now add a few supplementary dimensions of the teeth: m^{1-3} , 4.9; crown of m^1 , 1.85×2.3 ; of m^2 , 1.8×2.4 ; of m^3 , 1.2×2.2 .

The palatal branches of the premaxillary bones are complete.

¹ 1827, Monographie de Mammalogie, I, p. 228.

² *Op. cit.*, II, pp. 352-354.

³ 1838, Mus. d'Hist. Nat. des Pays-Bas, XII, p. 202.

⁴ 1936, Natuur. Tijdschr. Ned. Ind., XCVI, pp. 50-51.

Mops sarasinorum (Meyer)

Nyctinomus sarasinorum MEYER, 1899, Abhandl. u. Berichte K. Zool. Anthropol.-Ethn. Mus., Dresden, VII, No. 7, p. 16.

TYPE LOCALITY.—Batulappa, north of Tempe Lake, S. W. Central Celebes.

MATERIAL.—20 specimens from the lowlands of Peleng Island, Celebes.

The animals of this series agree in every way with Meyer's description, which was made from a single female. In young animals the dorsal color is very much darker—near Fuscous Black¹—and the chestnut-brown is gradually assumed at maturity. A number of individuals are in the transitional stage, a blackish chestnut. The nude condition of the crown of the head is already developed, even in quite young specimens. The dorsal hairs of the neck just anterior to the scapulae are much thinned.

Meyer's description of the spacing of the upper incisors, the absence of the small upper premolar, and reduction of p_2 —all agree well with the condition found in our series. It appears from the wording of his account that the skull had not been cleaned when Meyer described *sarasinorum*.

In our specimens, e.g., A.M.N.H. 109064, ♀, paired incisive foramina are clearly defined, the intermolar spaces are ample,

and m^3 is very much reduced. The ante-orbital processes are prominent. Slight sphenoidal depressions are observable. In the mandible, p_2 is considerably smaller than p_1 in all of its dimensions.

Measurements of A.M.N.H. 109064: forearm, 40 mm.; occipito-canine length, 17.8; zygomatic width, 12.0; mastoid width, 11.0; least intertemporal width, 4.6; $c-m^3$, 7.2.

The obsolete p^2 and reduced p_2 , coupled with the complexity of the ears, indicate the relationship of *sarasinorum* to *Mops* and to *Philippinopterus*.³ *Sarasinorum* is more heavily built than *P. lanei* as shown by their respective tooththrows ($c-m^3$, 7.2: 5.2–5.7 mm.). Neither one, because of the structure of the ears, can be referred to *Mormopterus* Peters.

I have not seen an example of *Philippinopterus*. But Taylor's description, which does not state the character of m^3 , appears otherwise to agree closely with the definition of *Mops* offered by Thomas.⁴ Similar curtailment of the W-pattern of m^3 can be observed in several American genera. The classification of these genera is difficult; not only the genus *Mops* but the interrelationships of the Molossidae as a whole require further study.

REMARKS ON MORMOPTERUS PETERS

Mormopterus PETERS, 1865, Monatsber. Akad. Wiss. Berlin, p. 574.

GENOTYPE.—*Nyctinomus jugularis* Peters, from Madagascar.

Mormopterus, monographed by Peters² in 1881, was held to include three Mascarene species, *jugularis*, *acetabulosus*, *setiger*, and two New Guinea–Australian species, *beccarii* from Amboina and *norfolcensis* from Norfolk Island and Eastern Australia. *Astrolabiensis* Meyer appears to be related to *Mormopterus*. Later Andersen added *doriae* from N. W. Sumatra.

All of these species are united by possessing relatively thin, broad, un-united,

unspecialized ears, scarcely wrinkled lips, unreduced m^3 . In these respects they are less specialized than *Chaerephon*. But they show also specializations lacking in the last-named genus: the open premaxillae, presence of a gular sac, and obsolescence of p^2 (except *norfolcensis*⁵ and *beccarii*).

An American branch of the genus containing the species *kalinowskii* (Thomas), *minutus* (Miller), *peruanus* Allen, was recognized, with i_3 absent in all three species and p^2 present in *peruanus*.

³ Taylor, 1934, "Philippine Land Mammals," pp. 314–320.

⁴ 1913, J. Bombay Nat. Hist. Soc., XXII, pp. 89–91.

⁵ Third lower incisor apparently retained in *norfolcensis*, see Peters' plate (*loc. cit.*).

¹ Ridgway, 1912, "Color Standards and Color Nomenclature."

² 1881, Monatsber. Akad. Wiss. Berlin, pp. 482–485, plate.

Recently Iredale and Troughton¹ have proposed the generic term *Micronomus* for *Molossus norfolcensis* Gray. Under the findings of the International Congress² this name, as well as others proposed in the

¹ 1934, Mem. Austral. Mus., VI, p. 100.

² 1939, X^e Congrès Int. Zool., Budapest, p. 1589.

same work by the same authors, is invalid.

Apparently the only Old World representatives of the genus *Mormopterus* present in American museums are specimens of *norfolcensis*, at U. S. Nat. Mus., Washington, D. C., and Mus. Comp. Zool., Cambridge, Mass.

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SOME NEW AND INTERESTING NEUROPTERA IN THE AMERICAN MUSEUM OF NATURAL HISTORY

BY NATHAN BANKS

In examining some foreign Myrmeleonidae and Chrysopidae belonging to The American Museum of Natural History I have found several new species which are herewith described. There are also present some described species which were new to me or are uncommon in collections. Notes on these forms are given, calling attention to various characters not stated in the original description.

MYRMELEONIDAE

Layahima chiangi, new species

Head with a large interantennal mark, extending below in a truncated lobe, and above half-way to vertex; lower face pale; vertex pale, with two large black spots each side near eyes, the hinder pair farther apart than the front pair, all on slightly elevated areas; antennae brown to black; pronotum pale, with a dark spot in middle behind, and four spots on each side, one at posterior angle, three others forming a triangle; rest of notum heavily marked with black, leaving various small pale spots, two on anterior lobe, a larger one over base of fore wings, scutelli show a double basal dark mark, sometimes reaching the tip; abdomen black, with a pale spot above near middle on each segment; in the male these pale spots are so enlarged that the second and third segments are almost wholly pale, hairs on abdomen short and mostly dark; legs pale, much marked with dark, and with much dark and some white hair, femora mostly dark near base, tibiae dark toward tips, and front pair on outer side, tarsal joints dark at tips.

Fore wings hyaline, with two large and several smaller brown spots, one large one up from rhagma, other large one up from end of anal vein to cubitus, three smaller along cubital space, other small one at base of the white stigma, and several along radius over certain cross-veins, many minute ones over marginal forks and apical areas. Veins alternately brown and white, many cross-veins dark and these sometimes margined, others snow-white, a large patch of these just before the dark above rhagma. Hind wings largely unmarked, but a spot at rhagma and outer margin along the marginal forks dark.

Vertex elevated, as in *L. nebulosa*; pronotum shorter than broad, with short dark hair and long curved pale bristles; abdomen and legs similar to *nebulosa*, spurs about equal two tarsal joints, the basal joint very long.

In fore wings the costal area is divided into two series of cells mostly as far as origin of radial sector, in all specimens farther based than in *L. nebulosa*; usually six cross-veins before radial sector, one or two cells crossed, about ten branches to radial sector, twelve to sixteen cross-veins in cubito-anal area, rarely one or two cells crossed as in *nebulosa*; the second anal is connected to third by a cross-vein, and a little beyond is a cross-vein up to first anal, usually also a second cross-vein back to first anal; the union of the end of anal vein and the cubital fork is nearer to margin than in *L. nebulosa*, the cubital fork being longer and not so nearly vertical as in *nebulosa*.

In hind wings one cross-vein before radial sector; nine branches to radial sector; first anal vein has one connection to the cubital fork; apical area with a few cross-veins; before origin of radial sector the medius curves down and farther out up again.

Length of fore wing, 29 to 31 mm., width, 9 to 10 mm.

From Loutsechiang, Yunnan, China. Accession No. 24141. Type in The American Museum of Natural History, paratypes also there and in Museum Comparative Zoölogy. Most readily separated from *L. nebulosa* by the absence of the numerous minute black dots which in *nebulosa* are found on the pale parts of thorax and abdomen.

Nuglerus scalaris Navas

This was wrongly described as from Brazil, but other similar forms occur in the Orient, and nothing like it in South America. This specimen is labeled "Northern India"; it agrees well with a photograph of the type sent by Esben-Petersen. As in other species of the genus there is a brown bulla in the apex of each wing; in this species it is nearly circular; between the medius

and the cubitus is a series of slender oblique black marks ending in a larger spot at the rhexma; between this and the apical bulla is one brown spot covering a few veinlets. In the fore wing the second anal runs in an even curve just touching the third anal, with two cross-veins back to first anal vein, the first at the junction with the third anal, the latter forked. In fore wing three cross-veins before radial sector, in hind wings two, in fore wings three cross-veins between first anal vein and cubital fork, the union being rather far from the hind margin; in hind wings it is difficult to tell which is the cubital fork; the first oblique branch from the cubitus (no thicker than others) is just before the first forking of the radial sector.

The pronotum is long and slender; there is a black stripe through the middle of pleura; the spurs are long, curved only near tip, more than twice as long as the claws, and equal to two tarsal joints, the basal joint being longer than the apical.

Epicanthacalis moiwasana Okamoto

This is uncommon, and absent from many collections. There is one specimen from Yokohama, Japan; it agrees well with a paratype from Sapporo, but not quite so dark. In this specimen the second anal vein runs a little nearer to the third than to the first anal (in paratype half-way between), as in paratype both second and third anals are forked, and two connections from second back to first anal. The radial area before the radial sector and the cubito-anal area are both divided by cross-veins for a short distance.

These three Oriental genera of the subfamily Dendroleoninae can be distinguished from their allies in the following table.

The Navasian genus *Cuca* is unknown to me; from description it is probably near *Dendroleon*. Nor have I seen *Thaumatoleon* Esben-Petersen from Formosa. If it goes in this subfamily, it will run to number 5, and since in the photograph the anal vein appears straight it will go to number 6; there it would separate as the costal cells are not divided, and the spurs are very short.

Dendroleoninae

- 1.—In hind wings the cubitus and anal plainly sinuous and parallel for a long distance; in fore wings all branches of the anal are connected by cross-veins; basal tarsal joint much shorter than apical; palpi very long. *Echthromyrmex*.
In hind wings the cubitus at least straight to the forking; in fore wings at most only a few anal branches connected by cross-veins; palpi not elongate 2.
- 2.—In hind wings the radial sector arises beyond the cubital fork; often three or four cross-veins before the radial sector, legs rather stout, basal joint of tarsi often not equal to next two together. . . 3.
In hind wings the radial sector arises at least a little before the cubital fork; not more than two cross-veins before radial sector, basal tarsal joint often elongate. 5.
- 3.—No spurs to tibiae; legs slender, basitarsus longer than the next three together. *Maracanda*.
Spurs present. 4.
- 4.—Spurs equal only first tarsal joint; three cross-veins before radial sector in hind wing. *Lopezus*.
Spurs equal to two tarsal joints; four cross-veins before radial sector in hind wing. *Solter*.
- 5.—In fore wings the anal vein plainly bulges forward, so that the anal area is distinctly a little broader here than at middle of length; if any costals crossed, it is only in apical part near stigma. . . 7.
In fore wings the anal vein runs straight to near tip, so that the anal area is no wider beyond middle than elsewhere; costals crossed almost to base of wing. . 6.
- 6.—Hind spurs three times as long as claws; wings very slender; legs also extremely slender, hind tibia longer than width of hind wing. *Phanoleon*.
Hind spurs not twice as long as claws, wings moderately broad, legs rather stout, hind tibia not as long as width of hind wing. *Epicanthacalis*.
- 7.—Some costals crossed beyond middle of wing; legs not very slender; hind spurs not twice as long as claws; the radial sector in fore wings arises only a little before the cubital fork. *Layahima*.
No costals crossed (or only one or two); legs more slender. 8.
- 8.—Outer margin of fore wings concave before tip, large species with large dark spots near wing-tip. 9.
Outer margin not plainly concave. 10.
- 9.—Cross-veins in apical area; cubital fork nearly at right angle to cubitus. *Indoclytus*.
No cross-veins in apical area; cubital fork at an acute angle to cubitus. . . *Neghurus*.
- 10.—In hind wings two cross-veins before radial

sector; hind wing longer than fore wing; a bulla or swollen area near each wing-tip..... *Nuglerus*.

In hind wings but one cross-vein before radial sector; no bulla near wing-tip. 11.

- 11.—At middle of costal margin many cells six times as high as long; no cross-veins in apical field..... *Borbon*.

At middle of costal margin cells not over four times as high as long, cross-veins in apical field..... 12.

- 12.—In both wings beyond the cubital fork the medius and cubitus are plainly convex in front; some large spots on wings..... *Dendroleon*.

In both wings beyond the cubital fork the medius and cubitus run out practically straight, no large spots on wings *Gatzara*.

Nepsalus is a fully colored specimen of *Neglurus*. *Bofia* and *Bullanga* are synonyms of *Nuglerus*. *Nowes* is but little different from *Layahima*; the pronotum is longer than broad, and the venation lacks the irregularities so common in *Layahima*, so *Nowes* might be retained as a subgenus.

Indoclystus, a new genus, is made for the *Glenurus singularis* Westwood of India. It has been placed in *Periclystus* Gerstaecker, an Australian genus. *Indoclystus singularis* differs from *Periclystus* in the shape of the fore wing, the hind margin beyond the anal vein being convex (in *Periclystus* concave); prominently in that the cubital fork is nearly at a right angle to the cubitus; (in *Periclystus* at a very acute angle, as is common in most Myrmeleonidae).

Periclystus callipeplus Gerstaecker is the type of *Periclystus*.

Lacroixia siberica Navas

Described from Irkutsk, Siberia, two specimens from Tsaganor, Mongolia, July, 1922. Accession No. 23974.

This is a fine little myrmeleonid with yellowish venation lightly interrupted with dark spots, and in one specimen there are dark spots at the marginal forkings and on outer cross-veins, and at each end of the anal branches. In the fore wings there are five or six cross-veins before the radial sector, six or seven branches to radial sector, four or five cross-veins between first anal and the cubital fork. The area just before the radial sector is about twice as broad as the costal area; the anterior

banksian line is present, but the posterior is only indicated faintly; two or three cross-veins in apical area. In fore wing the second anal vein is united for a short distance to the third anal and after separation there is a cross-vein back to the first anal.

In hind wings there are two cross-veins before the radial sector, only one cross-vein between anal vein and cubital fork, and usually one in the apical field. The only other genus of the Oriental region in the Macroneurini with two cross-veins before the radial sector in the hind wings is *Deutoleon*. *Deutoleon* has many stout spines on the femora, while *Lacroixia* has but few and slender ones, and *Lacroixia* has no double series of cells in the cubito-anal area so characteristic of *Deutoleon*.

Psammoleon posticus, new species

Head with a large, dark interantennal mark extending up to first vertex row, and between that and second vertex row it is also dark; lower face and clypeus pale; antennae dark brown, strongly clavate; palpi mostly pale, last joint but little swollen; pronotum dark, with a curved pale stripe on each side, sometimes not complete, pronotum above with much white hair; rest of thorax above dark brown, with a few small pale spots; abdomen nearly black, on several segments is a pale spot before the middle, short white hair above, longer beneath. Femora mostly brown, pale on base; tibiae pale, dark at tip, and front pair dark near base; tarsi pale, tip of last joint black, hairs and spines mostly black, but some white hair and bristles on the femora; spurs about equal three joints or a little more. In fore wings the pale veins are much streaked with dark, many cross-veins dark, others wholly pale, marginal forks dark at bases, dark spot at rhagma, and beyond it some cross-veins are bordered with dark, somewhat in a row; a small dark spot near end of anal vein; stigma dark at base.

In hind wings the veins and cross-veins partly dark, and at rhagma is an elongate dark streak, the bases of marginal forks dark as in fore wings. Fore wings slender, not broadened toward tip; eight cross-veins before radial sector, cross-veins in apical area as usual; the anal vein runs almost parallel to the cubital fork for a distance equal to width of wing, and there are nine to twelve cross-veins between them (in most species rarely more than five); eleven branches to radial sector. Hind wings a little shorter and more narrow than fore wings, ten branches to radial sector, only one cross-vein connecting the first anal to cubital fork. Pronotum broader than long, sides nearly parallel.

Length fore wing 24 mm.

Two from Colombia. Accession No. 4979.

Type in The American Museum of Natural History, paratype in the Museum of Comparative Zoölogy.

It agrees with *P. parallela* Banks from Honduras in having the anal and cubital fork nearly parallel for a long distance, but differs in having the streak in hind wings, and different marks on fore wings.

***Bandidus canifrons* Navas**

From Victoria, Australia (Edwards). It was described from "Australia," and I have seen it from The Creel, Mt. Kosciuszko, New South Wales, in December. E.-Petersen records it from New South Wales (Froggatt coll.), and places it in his genus *Alloformicaleon*, and makes no reference to the subgeneric name given by Navas. However, Navas is wrong in considering *Alloformicaleon* as a synonym of *Bandidus*, since the genotype of *Alloformicaleon* (*australis*) has but one cross-vein before the radial sector in the hind wing.

The species has much resemblance to typical *Distoleon* (*verticalis*), but in the fore wing there is no bending of the branches of radial sector, nor of the cubitus to form a line, which is so evident in *Distoleon*.

In fore wings there are a few cells of the cubito-anal area crossed, and sometimes the origin of the radial sector is about as far basal as the forking of the cubitus. In the hind wing there are but one or two cross-veins from first anal to the cubital fork.

***Obus infirmus* Navas**

A good series of this little African antlion fly comes from Capolongo, Angola, July 25, Pico Avezedo, Angola, July 23 to 27, and from Table Mountain, Cape Colony, November.

It is a much smaller and less-marked species than *O. elizabethae* of Natal and eastern Cape Colony. The venation is practically the same; there is the oblique veinlet from near the base of the radial sector extending basally to join the medius. The vertex is not plainly bilobed; the sec-

ond and third anals of fore wing unite for only a short distance. Sometimes the second as well as the third anal vein is forked, and often there is a cross-vein from the third anal to the second beyond their separation..

The type was described from "Karabih, S. W. Afr."

***Myrmeleon orestes*, new species**

Head pale yellowish, a large black inter-antennal mark reaching roundly down to the clypeus and up to the first vertex-row, sometimes a little dark on the clypeus; below antennae this mark is shining, above antennae dull; on vertex is a broad median black stripe back to thorax, and each side by eyes is a curved black mark, not reaching the median mark; antennae black at base, becoming paler, and the tip shows some yellowish above; last joint of maxillary palpi dark brown; pronotum with a median black stripe, slightly widened near front, and each side is a dark stripe to the furrow, and there connected to the median stripe.

Mesonotum mostly dark, usually two pale spots on the anterior lobe, two pale on each lateral lobe, and the sides and hind margin of the scutelli pale; metanotum also dark, with two pale spots near middle; abdomen brown, tips of the segments often narrowly pale, with white hair, tip of last segment and the whole of the genitalia almost white; legs pale, hind femora more or less darkened in middle, other femora somewhat yellowish brown above; hind tibiae dark on inner sides, other tibiae often dark at tip, and sometimes the tips of tarsal joints dark; claws and spurs rufous.

Wings hyaline, veins pale, the subcosta plainly with dark streaks, usually fainter ones on radius, and usually some on cubitus near the forking, and sometimes a few dark dots on radial veins, or some other veinlets; hind wing with pale veins but the radial sector usually dark.

Pronotum plainly longer than broad, somewhat narrowed in front, with white hair; legs rather slender, the tarsi long, spurs not equal to basitarsi; claws but little curved, basal half of hind femora with a few spines below, none beyond. Fore wings with eight to ten cross-veins before the radial sector, in hind wing six before radial sector; in all six specimens there are two radial sectors in the fore wing, in one of them three radial sectors, the first branches rather far out, the second soon after origin; in anal field of fore wings there is one cross-vein from second anal to the first branch of the first anal, but no further connections; in apical area of fore wing is a series of cross-veins, none in hind wings; the hairs on veins are short but beyond middle become longer.

Expanse 44 to 50 mm.

From Lobito Bay, Angola, April, Capolongo, Angola, July 25, type (both in Amer.

Mus. Nat. Hist.), Pretoria, South Africa, March 12 (Powell coll.), and Kimberly, South Africa, May (in Mus. Comp. Zool.).

Related to *M. doralice* Banks, and since both have the two radial sectors it might be well to use *Myrmelodes* as a subgenus. It can be separated from *M. doralice* by smaller size (fore wing, 20 to 23 mm., in *doralice* 28 to 30 mm.), by the dark streak on middle of hind femora, and especially by the white tip to abdomen.

CHRYSOPIDAE

Bornia solomonis, new species

Face yellowish, a black spot under each eye; vertex with some faint brown marks in front; antennae pale; pronotum broadly black on sides, pale stripe through middle; rest of thorax brownish, not plainly marked; abdomen nearly black above, venter pale, the segments (except last) with a black apical band; legs pale, unmarked. Wings hyaline, veins pale, sometimes with a dark dot at a veinlet connection, the cross-veins, gradates, and branches of radial sector mostly wholly dark brown, the gradates bordered with brown, the inner row most strongly, marginal forkings brown, and often one side of the fork dark, the cross-vein behind third cubital cell margined with brown; the stigma pale fulvous, each of the three or four cross-veins in the subcostal part of stigma is covered with a broad, rounded dark brown spot.

In hind wings the same veins as in fore wing are dark brown, and the outer gradates bordered, and here also there are three or four dark brown spots in the subcostal part of stigma.

In the fore wing there are four free intermediates; about seven or eight inner gradates, eight or nine outer gradates, the middle row varies much, in one specimen but one gradate, usually from four to six; seven cubitals beyond the divisory cell, latter is about twice as long as broad at base and ends well beyond the cross-vein above, the base of divisory cell is only slightly oblique, hardly one-half as long as the outer side, and not thickened. In hind wing are eight or nine inner gradates, six or seven outer gradates, sometimes one or two of a middle series, the inner row extends far basally, and the veinlets mostly far from each other.

Length of fore wing 15 mm., width 5.5 mm.

From Malaita, Solomon Island. Accession No. 30985.

Type in The American Museum Natural History, paratype in Museum Comparative Zoology.

In appearance this is much like certain *Anomalochrysa*, and the only character to separate it is that the basal side of divisory is not strongly oblique and as long, or nearly so, as the outer side, and this basal part is not thickened, but some species of *Anomalochrysa* do not have the base thickened (*A. frater*).

Nadiva balboana, new species

Body thick and heavy, with stout legs and thick antennae hardly as long as fore wings, similar to *N. valida* and *N. panchlora*. Yellowish, a faint reddish mark under each eye; antennae somewhat infusate, especially below; no marks on pronotum nor thorax; abdomen and legs pale. Wings with greenish venation; stigma long, yellowish. In fore wings the gradates are wholly dark brown, and the radial cross-veins dark in middle (not at ends), no other veins darkened. In the hind wings all the veins are pale. The fore wings have the shape of allied forms; the third cubital cell is like *Leucochrysa*, divided by a plainly, but not strongly, sloping veinlet (in all three specimens); eight cubital cross-veins beyond the divisory cell.

The branches from cubitus to margin are nearly all unforked (usually forked in allied species); the gradates are slightly divergent, nine or ten in each row, the inner row not extending basally, the outer row parallel to the outer margin. The postcubital space is not as much broader than the cubital as in related species; the costal area at the widest is not equal to the radial area; in the hind wings there are eight or nine gradates rather far apart; the base of the radial sector and the medius are united for quite a distance.

Length of fore wing, 17 to 19 mm., width, 6 to 6.3 mm.

From Barro Colorado, Canal Zone, February 12, 26, March 17 (Gertsch, Lutz, Wood). Type in The American Museum Natural History, paratypes there and in Museum Comparative Zoology.

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A NEW OLIGOCENE INSECTIVORE

By GEORGE GAYLORD SIMPSON

The specimen described in this paper was found in the Oligocene exposures at Pipestone Springs, Montana (see Matthew, 1903), by Mr. R. Thompson in 1940 and by him presented to the American Museum. Besides representing a clear-cut new species, it adds to morphological knowledge of the interesting genus *Domnina*. This genus, formerly very confused as to nomenclature, structure, and relationships, has recently been splendidly clarified by Patterson and McGrew (1937), to whom reference is made for discussion of such characters as are not differential or additional in the present specimen. On contemporaneous insectivores see Scott and Jepsen (1936) and Clark (1937).

Domnina thompsoni,¹ new species

TYPE.—Amer. Mus. No. 32647, left lower jaw with alveoli of I_1 and P_{1-4} , crowns of M_{1-3} , and most of the postdental portion of the jaw.

HOLOTYPE.—Type only.

KNOWN OCCURRENCE.—Chadronian beds of Pipestone Springs, Montana.

DEFINITION.—Antemolar dentition less reduced than in *D. gradata*, five alveoli between molars and I_1 . Molars and jaw smaller throughout. Molar structure and proportions about as in *D. gradata*.

The alveoli between I_1 and the molars occupy a space 1.9 mm. in length, relatively larger than in *D. gradata*, and are five in number, subequal but the first and fifth largest. The first two are markedly procumbent and the following three progressively less so. A root is preserved in the last alveolus while the others are full of matrix, a fact that suggests, but does not prove, that P_4 was not two-rooted. The relatively unreduced antemolar dentition is remarkable for a soricid and might even warrant generic distinction, but these teeth are known only from alveoli and the

molar structure is practically identical with that of *Domnina gradata*, so that such a step would be unjustified on this material. The indication of more primitive structure is to be expected in an earlier form, *D. thompsoni* being Chadronian (Lower Oligocene) while all the known specimens of *D. gradata* are probably Orellan (Middle Oligocene).

The postdental part of the lower jaw has hitherto been almost unknown in *Domnina*. Except for the angular process, it is well preserved in this specimen and is adequately shown in the accompanying figure. In general it is about what would be expected in a form definitely soricid but primitive in that group. Patterson and McGrew (1937, p. 255) noted inconclusive evidence of an intertemporal fossa in *D. gradata*. In *D. thompsoni* there is a concavity in the region where this fossa develops in later soricids, but it is neither deep nor sharply bounded.

In the following table measurements are compared with those given by Patterson and McGrew for *D. gradata*. For the latter species I have also calculated an estimate of what the range would be in a sample of 1000 specimens, in which it would more nearly approximate the population range. I propose to call this figure the "standard range from observed range" or "S.R. (O.R.)." It is calculated from Tippet's tables (1925) of mean ranges in terms of standard deviation for samples of various sizes. Thus in samples of 5 specimens the range tends, on an average, to be 2.33 times the standard deviation while in samples of 1000 specimens it tends to be 6.48 times the standard deviation. Therefore in the large "standard" samples of 1000 specimens the range tends to be 6.48/-2.33 = 2.78 times as large as in samples of

¹ For Raymond Thompson, the collector.

5 specimens and an estimate of range at that standard sample size can be obtained by multiplying the range observed in 5 specimens by 2.78. This estimate is subject to rather large standard error, and yet it can serve many useful purposes, especially as a rough and easy check where more tedious statistical methods are not necessary, or to decide whether it is worth while to employ these. It has the further advan-

these measurements and it confirms the conclusion drawn from the new standard range method.

Of the eight measurements available, those of *D. thompsoni* are below the standard range for *D. gradata* in 3 cases, at the lower limit of that standard range in 4 others, and within the standard range in only 1, the length of M_3 . The legitimate conclusion is that the chance that a speci-

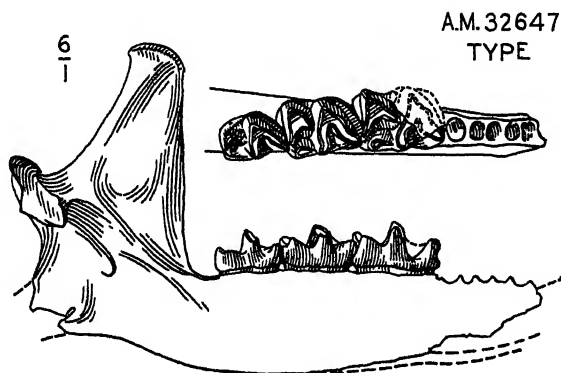


Fig. 1. *Domnina thompsoni*, new species. Left lower jaw, internal view, and molars and ante-molar aveoli, superior view. Type, Amer. Mus. No. 32647. Six times natural size. (Drawn by J. C. Germann.)

tage of being more graphic and more nearly related to the concepts and methods to which paleontologists have been accustomed. In the present case an appropriate refined method would be "Student's" relatively laborious *t*-test. As a check, this has, in fact, been applied to several of

men of *D. gradata* as small as the type of *D. thompsoni* will ever be collected is very small, so small that it may be ignored for practical purposes and it may be taken that *D. thompsoni* ranges below the limits of individual variation in *D. gradata*. Measurements are in millimeters.

Variate	<i>D. thompsoni</i> , Type		<i>Domnina gradata</i>		
		Number of Specimens	Mean	Observed Range	Standard Range- S.R. (O.R.)
Depth of ramus under M_1	ca. 2	5	2.4	2.2-2.5	2.0-2.7
Length M_{1-3}	4.8	4	5.7	5.4-5.8	5.0-6.3
M_1 :					
Length	1.8	4	2.3	2.2-2.5	1.8-2.8
Width	1.2	5	1.5	1.4-1.5	1.3-1.6
M_2 :					
Length	1.5	5	1.9	1.8-2.1	1.5-2.4
Width	1.1	5	1.3	1.2-1.4	1.1-1.6
M_3 :					
Length	1.3	4	1.6	1.5-1.8	1.1-2.1
Width	.8	4	1.1	1.1-1.2	1.0-1.3

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NEW AMERICAN SYRPHID FLIES (DIPTERA)

By FRANK M. HULL¹

Descriptions of three new species of flower-flies (Syrphidae) are given in this paper, and I am indebted to Dr. C. H. Curran for the privilege of studying and describing them. The types are in The American Museum of Natural History.

Mixogaster strictor, new species

Large, petiolate, brown species without obvious mesonotal vittae or fascia; wings with a brown anterior border and subapical cross-vein with an outwardly directed spur beginning above the middle of the cross-vein. Related to the *conopsis* Macquart group but with different thorax, etc.

MALE.—Length 9 mm. to where the abdomen is deflected downward at the end of second segment, remaining three segments 4 mm. long. Wing 9 mm.

HEAD: considerably wider than thorax, the occiput dark brown. There is a very dark brown transverse band across the front from eye to eye, which is confluent with a similar area on the upper edge of the antennal prominence and upon all of the region of the vertex and ocellar triangle except the area just back of the ocelli. Just back of the ocelli the rounded swollen area is dark reddish. There is a narrow transverse band from eye to eye on the upper part of the front, just below ocellar triangle, which is light brownish yellow and slightly reddish. Face very convex viewed from above; straight in profile for the greater part of its length or height and receding gently on the lower third. Cheeks absent in profile. Face light yellow-brown with a slender median brown stripe and a more slender, slightly curved stripe on the middle of each side of the face that grows wider as it reaches the epistoma. All three stripes proceed from the base of the antennae and the outer stripes are curved outwardly, convex. Eyes bare, widely separated by four-fifths of the eye width. Antennae elongate, the first joint nearly as long as the other two, the second joint two-fifths as long as the third joint and very narrow at its base from which it quickly flares out over its short length. Arista much thickened basally, not as long as the third joint. THORAX: convex, a little longer than wide, the dorsum entirely dark, dull shining brown,

with extremely short-appressed, reddish, bristly pile, and without obvious stripe on the dorsum anywhere. The narrow sides of the thorax from and including the humeri, the post calli and the entire scutellum light yellow. Scutellum very short and convex. Metanotum conspicuous and brown. ABDOMEN: elongate and pedunculate, the second segment narrowest at about a fourth the distance from its base. The length of the second segment is about three and a half times its narrowest width, four times as long as at its narrowest width and on its posterior margin it is at least one and a half times as wide as the narrowest width. The remainder of the abdomen consisting of the third and fourth segments and conspicuous hypopygium are enlarged into a club-shaped body which is thrust downward at a right angle. First and second segments light reddish brown, shining, a little bit darker upon the first segment and on either side of the second segment past the middle. The margins of the second segment are deeply creased and the extreme tip of this segment is almost yellow. The remaining segments are dark brown, quite densely appressed setate, the hind border of the third segment and a narrower border upon the posterior part of the fourth segment brownish yellow. LEGS: dark brown, the basal two-thirds of all of the femora light brownish yellow. WINGS: with the anterior border very pale gray and perhaps teneral, though there is no indication of it elsewhere. Veins brown, wings villose, stigmal cell pale. A stigmal cross-vein is present; the spurious vein is a mere fold.

HOLOTYPE.—One male, Piedra, Brazil, April, Williston Collection.

Lepidostola stellata, new species

Front with a radiate patch of golden scales just below the ocelli; mesonotal scales largely concentrated upon the posterior half; fourth abdominal segment sparsely scalose; legs chiefly brownish yellow. Related to *abdominalis* Lw., but scales sparse.

FEMALE.—Length 6 mm.; wing 5.6 mm.; antennae 1.7 mm.

HEAD: short and flat, wider than thorax, the eyes especially conspicuous. The vertex rather protuberant, shining black, the front slightly concave, though the region in front of the antennae is a little convex. The broad

¹ University of Mississippi.

central concavity or shallow part of the widening front is set with yellow scales, which radiate out from a central point. There is upon the lower part of the front, upon the eye margins a small, semicircular, white-pubescent spot. There is a larger similar spot upon the eye margins just opposite the antennae; it is narrowly connected below with a large vertical band of such pubescence lying upon the lower eye margins which is directed as a narrowing wedge down the sides of the face almost to the epistoma. Vertex, face, front and cheeks shining black. There is a small tubercle on the face just above the middle. Antennae quite elongate, the first two joints sub-equal in length, the third joint more than half again as long as the first two. The pendent antennae descend well below the base of the head or epistoma. The arista is slender. The eyes, if viewed from above, are much produced beyond the edge of the occiput laterally. THORAX: densely covered with yellow scales which are much more thickly set upon the posterior half of the thorax. There are a few on the posterior half of the humeri. The scales upon the mesopleurae are white. Scutellum shining black with no trace of scales, quite acutely triangular, the apex of the scutellum rather sharp, without being acute. ABDOMEN: broad, flattened, rather shining black with a very few scales only, narrowly on the sides of the third segment, and the whole of the fourth segment uniformly and sparsely covered with scales which are golden. Legs: entirely pale brownish yellow or orange, except that the outer half of the hind femora is barely darker and there is a quite narrow, not sharp, apical annulus of brown on all femora, except the middle pair, and a ventral streak of brown on the fore tibiae. The spines on the hind femora on either side are of a single row and are black as are the setae upon the base of the hind tibiae. WINGS: villose, the veins in the middle of the wing before the stigma very dark brown, almost black. Stigmal cell pale yellow, vena sputia practically absent, there being no more than a trace of a fold evident.

HOLOTYPE.—One female, São Paulo, Brazil.

There is in addition a male specimen in bad condition. The apical two-fifths of the hind femora of this specimen is dark brown; it bears the number 641.

Lepidostola trilineata, new species

Terminal part of abdomen with three vittae of thick, golden scales; anterior margin and suture of mesonotum thinly marginate with golden scales, and some lying before the scutellum. Not closely related to any now known species; the scutellum simple.

MALE.—LENGTH 5 mm. to end of second segment, remaining segment 2.5 mm. long; wing 5.6 mm.; antennae 2 mm. long.

HEAD: quite flat, wider than thorax, the vertical triangle small, with some golden scales behind the ocelli which are placed upon a low protuberance. Eyes touching for a distance equal the width by which the ocelli are separated. Sides of front along the eye margins densely golden scabrous and the sides of the eyes along the face, beginning opposite the antennae, covered by two large, somewhat semicircular spots of golden, quite microscopic pubescence that are more or less joined in to each other. There is also a median band of similar pubescence that begins just below the antennae, divides above the tubercle of the face and continues down the side of the face, merging with the lower of the two eye marginal spots. Epistoma fairly prominent, almost as far thrust forward as the tubercle. Cheeks brown and face and front, where not pubescent, shining black with somewhat of a steely blue cast. Antennae quite elongate, the second joint a little longer than the first and the third joint about as long as the second. First joint brownish yellow, the remaining two dark grayish brown. Third joint much flattened. Arista very slender. THORAX: the dorsum of the thorax dull black, with a pair of median gray vittae set close together, joined in the center as an H, but the posterior ends evanescent on the posterior fourth of the dorsum. There is a broad transverse anterior band of golden scales that becomes quite narrow as it borders the humeri and is continued down upon the mesopleurae as a sharp band of white scales. There is a narrow band of golden scales on the posterior margin of the suture of the dorsum, stopping at the root of the wing and again at the end of the suture in the middle of the mesonotum which end is also the outer margin of the gray vittae. A third band, almost as narrow, of thick golden scales begins just anterior to the posterior calli and circles the posterior part of the dorsum just before the scutellum. The remainder of the dorsum of the mesonotum is densely beset with tuberculate, extremely short, black setae. Scutellum short, free of scales, light brownish. ABDOMEN: barely narrower at the base of the second segment than upon the remainder of the abdomen. The abdomen is a little wider upon the base of the third segment. Sides of third and fourth segment each a little convex, the hypopygium prominent. First and second segments pale reddish brown, darker brown over most of the interior and apex of the second segment, and the basal half or more of the third segment and the narrow margins and apex of the fourth segment similarly colored. Remainder of third and fourth segments black and opaque. Upon the sides of the third and fourth segments, just inside the convex light brown margins is a slender, continuous vittae of thick golden scales. There is a similar narrow median vittae on the fourth segment and a transverse posterior marginal band of similar thick scales upon the end of the third segment, which is a little wider in the middle. The remainder of the fourth segment and of the

third segment, except the basal third, sparsely, uniformly scalose. Legs: dark brown; the hind femora, except a basal pale yellow annulus and an inner lateral apical elongate spot, dark blackish; the outer lateral surface of the front femora and the discal two-thirds of the front tibiae also blackish. The middle tarsi and the front two basitarsi, the basal half of the front femora and the anterior basal part of the middle

femora, light yellow. Remainder of legs brown. Hind femora with on each side a double row of very prominent long, sharp black spines. The anterior and middle femora, on the outer lateral sides only, with a similar single row of black spines. Wings: villose, pale grayish, stigmal cell yellow, vena spuria absent.

HOLOTYPE.—One male, Matto Grosso, Peru. It bears the number 347.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XLVII¹

NOTES ON THE GENERA *HALCYON*, *TURDUS* AND *EUROSTOPODUS*

BY ERNST MAYR

It has been considered advisable to publish the descriptions of several new *Halcyon* forms discovered by the Whitney South Sea Expedition, so that Mr. Peters will be able to include these forms in the

forthcoming volume of the Check-List of Birds of the World. The descriptions of several new forms of *Turdus* and of a new subspecies of *Eurostopodus* are included in the present paper.

NOTES ON *HALCYON CHLORIS*

A complete revision of the eastern forms of this genus is in preparation; the description of the present new forms shall, therefore, be introduced by just a few remarks. In 1931 I gave a preliminary classification of the superspecies *Halcyon chloris* (Mayr, 1931, Amer. Mus. Novit., No. 469, p. 3) which will have to be amended in several respects. To begin with, there is no adequate reason why *pealei* (Tutuila), *owstoni* or *albicilla* (Marianas), should be separated specifically from *chloris*. They differ only by minor color characters and are, furthermore, connected with *chloris* by intermediate forms. In the meantime it has also been pointed out by the Australian ornithologists that *Halcyon chloris* and *sancta* breed side by side over a considerable stretch of territory (coast of southern Queensland and northern New South Wales) and cannot, therefore, be considered as conspecific as Laubmann had proposed. Also a study of the forms of "*Todirhamphus*" has shown that they are nothing but aberrant offshoots of *Halcyon chloris*. Even though we do not propose to unite these flat-billed kingfishers of eastern Polynesia specifically with *H. chloris*, there is, at least, no question that the genus *Todirhamphus* is not valid.

All these findings have been used in a map published in the American Naturalist, 74 (1940), p. 274. A doubtful situation still exists in the Admiralty Islands where *Halcyon chloris anachoraeta* seems to connect the species *chloris* and *saurophaga*. An analysis of this situation is in preparation. Some remarks on the eastern Polynesian forms have recently been made by Berlioz (1939, C. R. IXme Congr. Orn. Int., pp. 87-91). It may be mentioned that no differences could be found between specimens of *sacra* from the various parts of the Tonga Islands. The differences between *sacra*, *rabulata* and *celada* (Wetmore, 1919, Bull. Mus. Comp. Zool., LXIII, pp. 197-198) are due to wear. I am very grateful to Dr. H. Friedmann for the loan of the Polynesian Kingfisher material of the U. S. National Museum, including the types of *rabulata* and *celada* and most of Peale's specimens. It may also be stated that *coronata* Peale, 1848, and *tutuila* Sharpe, 1892, are synonyms of *pealei* Finsch and Hartlaub, 1867; *platyrostris* Gould, 1842, and *minima* Peale, 1848, are synonyms of *recurvirostris* Lafresnay, 1842, and *cassini* Finsch and Hartlaub, 1867; *superciliosa* Gray, 1870, and *swensis* Sharpe, 1892, are synonyms of *vitiensis* Peale, 1848. These synonyms were created by authors who did not

¹ The preceding ten papers of this series are 977, 988, 1006, 1007, 1056, 1057, 1091, 1116, 1133 and 1144.

appreciate how strong seasonal, sexual and age variation is in *Halcyon chloris*.

For the methods of measuring and the terminology of body parts, see Amer. Mus. Novit., No. 469.

***Halcyon chloris manuae*,
new subspecies**

TYPE.—No. 202070, Amer. Mus. Nat. Hist.; ♂ ad.; Tau, Manua Islands, Samoa; December 24, 1923; Whitney South Sea Expedition (Beck and Correia).

ADULT MALE.—Similar to *sacra*, but loreal spot larger, ring-band wider and more deeply ochraceous; general coloration greener, even in worn plumage; nuchal collar blackish; axillaries often washed with ochraceous.

ADULT FEMALE.—Differs from that of *sacra* by wider ring-band, blackish nuchal collar and greener upper parts.

OFU.—Wing, 7 ♂ ad. 96–101 (98.9), 4 ♂ imm. 93–95.5 (94.2), 5 ♀ ad. 97.5–102 (100.3); tail, ♂ ad. 65–69 (67.1), ♂ imm. 66.5–67.5 (66.9), ♀ ad. 67.5–70 (68.9); bill, ♂ ad. 32.8–37.7 (35.9), ♂ imm. 35.8–37.5 (36.6), ♀ ad. 35.4–39.2 (36.6).

OLOSINGA.—Wing, 8 ♂ ad. 95–99 (97.4), 3 ♂ imm. 91, 92.5, 92.5, 8 ♀ ad. 97–102.5 (100.0); tail, ♂ ad. 63.5–69 (67.2), ♂ imm. 66, 66.5, 67, ♀ ad. 66–72 (69.0); bill, ♂ ad. 34.8–36.4 (35.5), ♂ imm. 31.5, 34.4, 35.8, ♀ ad. 32.0–37.7 (34.7).

TAU.—Wing, 14 ♂ ad. 97–100.5 (98.6), 4 ♂ imm. 94–95 (94.8), 4 ♀ ad. 100–102 (101.1); tail, ♂ ad. 65–68 (66.6), ♂ imm. 66–68 (67.0), ♀ ad. 68–72 (69.2); bill, ♂ ad. 35.2–39.4 (36.7), ♂ imm. 35.1–40.3 (37.6), ♀ ad. 37.1–37.8 (37.5).

RANGE.—Munua Islands (Ofu, Olosinga, Tau).

There are no differences between series from the three islands. This race differs from *pealei* (Tutuila) by the much narrower ring-band and collar, and by a larger blue spot on the ear-coverts.

***Halcyon chloris marina*,
new subspecies**

TYPE.—No. 249571, Amer. Mus. Nat. Hist.; ♂ ad.; Ongea Levu, Fiji Islands; August 4, 1924; Whitney South Sea Expedition (Mrs. Correia).

ADULT MALE.—Differs from *vitensis* by the larger loreal spots, by the broader ring-band, by the blacker nuchal band, by the paler under parts and the reduced or absent ocher wash on flanks and under wing. Differs from *manuae* by the presence of more phaeomelanin; crown and back are more greenish; lores, ring-band and flanks more ochraceous; the nuchal band is blacker, the size smaller.

ADULT FEMALE.—Differs from *vitensis* by the greener and more fuscous upper parts, by a broader ring-band, by a blacker nuchal band and by the absence of a buff wash on flanks and under wing. Differs from *manuae* by the greener color of crown and back and by a pronounced buffy ocher wash of lores, ring-band and collar; the black vermiculation on the sides of the neck is more pronounced. The blue *sacra* is very different.

Wing, ♂ ad. 92.5–99 (95.1), ♀ ad. 93.5–99 (96.2); tail, ♂ ad. 62–67 (65.1), ♀ ad. 63–69 (66.5); bill, ♂ ad. 33.9–39.6 (36.1), ♀ ad. 32.2–38.4 (36.0). These measurements are based on a series from Ongea Levu Island.

RANGE.—Lau Archipelago, eastern Fiji.

A discussion of the individual and geographical variation within the range of this race will be included in a revision of the entire species.

***Halcyon chloris eximia*,
new subspecies**

TYPE.—No. 249513, Amer. Mus. Nat. Hist.; ♂ ad.; Ono Island, Fiji Islands; October 31, 1924; Whitney South Sea Expedition (R. H. Beck).

ADULT MALE.—Differs from *marina* by larger size, more bluish upper parts, a narrower ring-band, paler (almost whitish) lores, more buffy flanks and under wing, and a more bluish nuchal collar. Differs from *vitensis* by larger size, paler lores and superciliary, a broader ring-band and by much paler flanks and under wing.

ADULT FEMALE.—Differs from *marina* by larger size, the much bluer upper parts and a narrower ring-band. Differs from *vitensis* by larger size, a broader ring-band, and less black vermiculation on the sides of the breast.

Wing, 8 ♂ ad. 97.5–101.5 (99.2), 6 ♀ ad. 100.5–105 (102.4); tail, ♂ ad. 66–70 (68.2), ♀ ad. 70–71.5 (70.9); bill, ♂ ad. 34.1–36.8 (35.2), ♀ ad. 33.0–38.6 (35.5).

RANGE.—Kandavu group (Kandavu, Ono, Yankuve, Ndravuni and Vanua Kula), Fiji Islands.

This subspecies is rather variable, in particular in regard to the width of the ring-band. The nuchal band is rather blackish in three males, bluish in five others. The posterior part of the ring-band is deep golden ocher in all of the adult males. The posterior part of the ring-band is whitish in three females, and buffy ocher in three others.

***Halcyon chloris regina*,
new subspecies**

TYPE.—No. 249742, Amer. Mus. Nat. Hist.; ♂ ad.; Futuna Island, central Polynesia; May

7, 1925; Whitney South Sea Expedition (J. G. Correia).

ADULT MALE.—Very different from all the other Polynesian subspecies of the species. Under parts washed with ocher, flanks, axillaries and under wing deep ocher; sides of breast and of neck vermiculated; crown, scapulars and back very greenish; wing-coverts, wing-feathers, rump and tail greenish blue; upper cheeks, ear-coverts and nuchal band greenish black; nuchal band rather narrow, more blackish than the ear-coverts; lores and ring-band rufous ocher; loreal spot rather large, feathers of forehead with ocher edges; ring-band very wide broadening behind the pileum into a large rufous ocher patch; collar rufous buff. Differs from *vitiensis* in the broad ring-band and the greenish upper parts, from *pealei* in the color of the under parts and by lacking the rufous white patch of the forehead.

ADULT FEMALE.—Unknown.

IMMATURE.—Of duller color throughout; ring-band narrower; nuchal collar more blackish; wing-coverts broadly edged with ocher.

Wing, 4 ♂ ad. 97+, 97.5, 98.5+, 99+, 2 imm. 94, 94; tail, 4 ♂ ad. 63, 63, 64, 66, 2 imm. 61, 61; bill, 4 ♂ ad. 32.3, 33.1, 33.1, 38.0, 2 imm. 30.1, 33.0.

RANGE.—Futuna Island, central Polynesia.

This subspecies is somewhat intermediate between *vitiensis* and *pealei*, but not particularly close to either. All four adult males (collected May 4-7) are completing their wing molt.

Halcyon bougainvillei excelsa, new subspecies

TYPE.—No. 225048, Amer. Mus. Nat. Hist.; ♀; Guadalcanar Island, Solomon Islands; July 26, 1927; Whitney South Sea Expedition (R. H. Beck).

Somewhat resembling *bougainvillei*, but differing in many respects; crown of a duller, more cinnamonaceous, less orange-rust color; malar stripe and nuchal band (from eye to eye) of a darker, more ultramarine blue, collar much narrower, not extending so far on the upper back; under parts much paler, pale ocher, instead of rusty orange; upper back and scapulars blackish olive, instead of cinnamon-olive-brown as in the female, or rich deep blue as in the male; turquoise blue field on lower back and rump reduced and more greenish; wings and tail of a dark dull purplish blue. Size as in *bougainvillei*: wing, 131; tail, 91; bill from nostril, 37.

RANGE.—Guadalcanar Island.

Unfortunately, only a single specimen, sexed as female, of this interesting new form was collected, which by its peculiarly soft plumage indicates that it might not be fully adult. The differences in the color of the back are so striking that further material might make it necessary to consider this form a full species. The type locality is at 4000 feet, inland from Cape Hunter, at the south shore of Guadalcanar Island.

ON SOME UNDESCRIBED RACES OF *TURDUS POLIOCEPHALUS*

An incomplete manuscript on this species was laid aside by me in 1933 because certain difficulties seemed to make a satisfactory revision impossible. It was hoped that the receipt of additional material from the Pacific islands might solve some of these difficulties, but, unfortunately, no collections have been made on the crucial islands during recent years. It was, therefore, decided to publish at least the descriptions of some of the new forms discovered by the Whitney South Sea Expedition.

The difficulties encountered by the reviser of the *Turdus poliocephalus* group are manifold. No specimens, except for the ancient types of *vanikorensis*, are available from Vanikoro Island in the Santa Cruz group, the first Polynesian island on which the species was discovered. This is the more unfortunate, since nobody

has yet been able to find a difference between the Vanikoro types and the population (*marensis*) from Maré Island in the Loyalty Islands. A small series, collected by the Whitney South Sea Expedition, on Utupua Island, Santa Cruz, agrees well with the description of *vanikorensis*, and is equally indistinguishable from three Maré birds. To make matters worse, there is a third population, on the islands Espiritu Santo and Malo in the New Hebrides, which equally lacks any characters by which it could be distinguished from *vanikorensis*. This subspecies has, thus, the paradoxical range: Vanikoro and Utupua, Santa Cruz Islands; Espiritu Santo and Malo, New Hebrides; and Maré Island, Loyalty Islands. The three blackish populations from the Santa Cruz group, New Hebrides, and Loyalty Islands,

which we unite under one name, have, in all probability, nothing to do with each other, phylogenetically, but are only so similar because the heavy pigmentation has covered up all the possible finer racial differences in a species which does not tend to much geographical variation in size.

It is curious that this species with its highly similar populations at far distant points should also have highly dissimilar subspecies on neighboring islands. The rather similar populations of Maré and Efate are separated by white-headed races on Lifu, Tanna and Erromango. Every one of the islands of the New Hebrides and Banks Islands has a population of this species which is slightly different from that of any other island. Much more remarkable, however, is the situation in the Fiji Islands. In this archipelago we find nearly all of the most extreme color patterns which occur throughout the range of *poliocephalus*. On Kandavu is the black *bicolor* with buff head and throat, on Ngau is a solid black bird, on Viti Levu and neighboring islands occurs the gray *layardi* with chestnut-brown abdomen and flanks, on Vanua Levu occurs the all gray *vitiensis*, and on Taviuni the black *tempesti* with gray head and throat. It is not surprising that some authors have put these different forms in four or five species.

***Turdus poliocephalus hades*,
new subspecies**

TYPE.—No. 252607, Amer. Mus. Nat. Hist.; ♂ ad.; Ngau Island, Fiji; February 20, 1925; Whitney South Sea Expedition (R. H. Beck).

Similar to *samoensis*, but of a deeper, more glossy black, head and throat not distinctly lighter than rest of body; size averaging larger, bill longer (24.1–24.9, against 22.9–24.3 in *samoensis*); outer edges of primaries not showing a distinct brownish wash; feathers of under parts of immature birds with prominent rufous-fusces edges. Darker and larger than *vanikorensis*.

MALE ADULT.—Wing, 110, 111; tail, 76, 79; bill, 24.1, 24.9.

RANGE.—Ngau Island, Fiji Islands.

This is the only black thrush in the Fiji Islands. Unfortunately, most of the seven specimens from this island are molting or immature, but the characters of the race

are sufficiently pronounced and the range isolated enough to justify the description of this population.

***Turdus poliocephalus efatensis*,
new subspecies**

TYPE.—No. 213152, Amer. Mus. Nat. Hist.; ♂ subadult; Efate Island, New Hebrides; June 24, 1926; Whitney South Sea Expedition (R. H. Beck).

Adult males indistinguishable from those of *vanikorensis* from Utupua. Subadult (first year) males distinctly lighter. Feathers of back in six of seven specimens with broad brownish-olive margins; only one bird black above. Under parts similar to coloration in subadult *vanikorensis* but the rufous brown margins of the feathers of breast and flanks are broader and more rufous, less cinnamon. One subadult female shows the same characters.

Wing, 8 ♂ ad. 101–109 (104.4), 6 ♂ subad. 96–103 (99.8), 1 ♀ subad. 97; tail, 8 ♂ ad. 67–73 (70.2), 6 ♂ subad. 62–68 (64.3), 1 ♀ subad. 64; bill, ♂ ad. 22–23.

RANGE.—Efate and Nguna Islands, central New Hebrides.

***Turdus poliocephalus becki*,
new subspecies**

TYPE.—No. 213142, Amer. Mus. Nat. Hist.; ♂ ad.; Mai Island, New Hebrides; July 12, 1926; Whitney South Sea Expedition (R. H. Beck).

Much lighter than *vanikorensis* or *efatensis*.

ADULT MALE.—Upper parts brownish black, not sooty black; feathers of back occasionally edged with olive-brown; under parts ash-gray; throat and upper breast distinctly paler and sharply set off from the dark ashy flanks and abdomen; feathers of flanks narrowly edged with pale ash-gray or with rusty gray; middle of abdomen whitish; under tail-coverts with narrow or broad white tips. Similar to *vitiensis*, but differing in being generally darker, in having the crown as dark as the back, in having a much darker gray throat and having more white on crissum and under tail-coverts.

ADULT FEMALE.—Differs from *efatensis* by being paler, particularly on the throat which is ashy, not fuscous black; feathers of flanks with broad rufous margins; feathers of back with narrow olive-brown undulation. Subadult male very much like female, but slightly darker.

Wing: Mai, 5 ♂ ad. 105–110 (107.2); Epi, 6 ♂ ad. 100–109 (104.5); Lopevi, 4 ♂ ad. 101–104 (103.0). Tail (♂ ad.): Mai, 70–76 (71.8); Epi, 67–75 (70.3); Lopevi, 69–71 (70.0). Wing: ♂ subad., Mai (3), 100, 103, 105; Epi (3), 99, 100, 100; Lopevi (3), 96, 99, 102; ♀ ad., Mai (1), 100; Lopevi (4), 97–100 (98.2). Bill, ♂ ad. 22–23; tarsus, 31–33.

RANGE.—Mai, Epi, Lopevi and Paama Islands, New Hebrides.

The birds from the mentioned four islands are not exactly identical and additional material might lead to further subdivision. The adult males from Mai and Epi are indistinguishable, but three subadult males from Epi are darker above and below than four subadult males from Mai, and have less pronounced rufous margins to the flank feathers. The Lopevi population is, more or less, intermediate between *becki* and the Malekula race; in fact, its pronounced variability suggests that it is a hybrid population. Of four adult males three agree better with *becki*, one better with the Malekula bird. The Lopevi females are grayish above, not olivaceous as Mai females. Subadult Lopevi males are darker above and below than Mai birds. A single Paama female (subadult) seems to agree with the Lopevi females.

***Turdus poliocephalus malekulae*,**
new subspecies

TYPE.—No. 214418, Amer. Mus. Nat. Hist.; ♂ ad.; Malekula Island, New Hebrides; August 23, 1926; Whitney South Sea Expedition (R. H. Beck).

ADULT MALE.—Similar to *vanikorensis*, but not quite as black, particularly on the under parts; throat and upper breast dark gray, distinctly lighter than blackish abdomen and flanks; crissum whitish; under tail-coverts with white or buffy white tips. Subadult male rather blackish above with inconspicuous grayish or olive-gray margins to the feathers, much darker than *efatensis*; underneath grayish black, paler than *efatensis*; feathers of flanks with narrow gray, not with broad rufous margins; much white on crissum and under tail-coverts.

ADULT FEMALE.—Rather similar to *becki*, but duller and grayer. Upper parts blackish olive-gray, instead of olive-brown; flanks and abdomen not rufous, but more or less gray; feathers with inconspicuous buffy gray margins; much paler and grayer than *vanikorensis*.

MALEKULA.—Wing, ♂ ad. (3) 106, 108, 109, ♂ subad. (3) 104, 105, 107, ♀ ad. (4) 99–107 (103.0), ♀ subad. (1) 99; tail, ♂ ad. 71, 76, 76, ♂ subad. 72, 73, ♀ ad. 67–73 (69.0), ♀ subad. 65; culmen 23–23.5; tarsus 31.

AMBRYM.—Wing, ♂ ad. (5) 103–109 (105.8), ♀ ad. 105, ♀ imm. 102; tail, ♂ ad. 70–75 (71.6), ♀ ad. 68, ♀ imm. 63; culmen 22.5–24; tarsus 31–31.5.

RANGE.—Malekula, (subsp.) Ambrym and (subsp.) Pentecost.

Only a single spotted nestling is available from Pentecost which does not permit racial identification. The Ambrym series

is lighter than the Malekula population, tending in the direction of *becki*, but closer to *malekulae* than to the Lopevi population of *becki*. The single adult female from Ambrym is, in fact, darker than the Malekula females. These differences are too slight to separate the Ambrym population subspecifically.

***Turdus poliocephalus whitneyi*,**
new subspecies

TYPE.—No. 214390, Amer. Mus. Nat. Hist.; ♂ ad.; Gaua Island, Banks Islands; September 11, 1926; Whitney South Sea Expedition (R. H. Beck).

ADULT MALE.—Small. Black as in *vanikorensis*, but upper throat paler and feathers of flanks with an indication of rufous margins; crissum white; under tail-coverts with white shaft-streaks. Subadult male as black above as *vanikorensis*, but rufous margins of flank feathers broader, throat paler and under tail-coverts with broader white shaft-streaks.

ADULT FEMALE.—Sooty black above with a slight brownish wash, below quite different from *vanikorensis*, but similar to *efatensis* by having broad tawny-chestnut margins to the feathers of abdomen and flanks; crissum white; under tail-coverts with broad white or buff shaft-streaks.

Wing, ♂ ad. 98, 102, ♂ subad. 97, ♀ ad. 95, 96; tail, ♂ ad. 65, 68, ♂ subad. 65, ♀ ad. 61, 61; culmen 22–22.5; tarsus 32.

RANGE.—Gaua Island, Banks Islands.

***Turdus poliocephalus placens*,**
new subspecies

TYPE.—No. 216298, Amer. Mus. Nat. Hist.; ♂ ad.; Vanua Lava Island, Banks Islands; November 10, 1941; Whitney South Sea Expedition (R. H. Beck).

ADULT MALE.—Small and pale. In color rather similar to *becki*, but crown darker, as dark or even more deeply colored than the back; throat and breast not conspicuously paler than belly and flanks; under parts rather scaly, since pale feather edges contrast with dark feather centers; feathers of flanks with pronounced rufous brown margins; crissum white, under tail-coverts with very narrow buffy white shaft-streaks.

ADULT FEMALE.—Similar to that of *becki*, but sootier, less olive, above; under parts also darker, flank feathers purer chestnut; crissum white, fairly broad white shaft-streaks on the under tail-coverts.

Wing, ♂ ad. 97, 97.5, 100, ♀ ad. 97, 100; tail, ♂ ad. 64, 64, 65, ♀ ad. 60, 65; culmen 21.5–22; tarsus 32–32.5.

RANGE.—Vanua Lava and (subsp.) Bligh Islands, Banks Islands.

A subadult male (w. 101, t. 69) and an adult female (w. 100, t. 69) from Bligh Island are best referred to *placens*. The female is exceedingly similar to *becki*, while the male is slightly darker than subadult *becki* males.

The iris is brown, bill and feet yellow in all the described races.

***Turdus poliocephalus bougainvillei*,
new subspecies**

TYPE.—No. 226229, Amer. Mus. Nat. Hist.; ♂ ad.; Bougainville Island; January 20, 1928; Whitney South Sea Expedition (G. Richards).

ADULT MALE.—In size larger than the blackish forms of the *vanikorensis* group, but smaller than the New Guinea forms of the *papuanensis* group. In size and coloration somewhat similar to *heinrothi* (St. Matthias), but darker and with shorter bill; head and throat well feathered; crown of the same color as the back; throat and upper breast a shade paler than the abdomen, but no distinct breast shield developed.

Differs from *rennelianus* by being paler and browner; crissum and under tail-coverts pure sooty brown, without any buff or white marks; differs from *vanikorensis* (Utupua) by larger size, by being of a duller, sootier black and by the absence of pale tips on the under tail-coverts.

ADULT FEMALE.—Similar to male, but smaller and back and rump with an olive-gray tinge; feathers of under parts with a somewhat scaly appearance due to fuscous outer margins.

Wing, ♂ ad. 111–114 (112.7), ♀ ad. 108, 108, 108; tail, ♂ ad. 82–87 (84.6), ♀ 79, 80, 80; culmen, 23–23.5; tarsus, 30–31.

RANGE.—Bougainville Island, Solomon Islands.

The typical series of this form was collected near the village of Kupei, about five walking hours west of Kieta, at an altitude of between 4000 and 5000 feet,

by a party consisting of Dr. F. P. Drowne, H. Hamlin and Guy Richards. Later on Hamlin collected two additional specimens in northeastern Bougainville on the slope of Mt. Balbi. These are larger (wing, ♂ 115, ♀ 110; tail, ♂ 88, ♀ 84), have longer bills (♂ 24.5) and seem to have broader margins on the abdominal feathers. It is not known whether or not they were collected at a higher altitude. The difference is too slight to justify subspecific recognition.

***Turdus poliocephalus kulambangrae*,
new subspecies**

TYPE.—No. 226253, Amer. Mus. Nat. Hist.; ♂ ad.; Kulambangra Island; September 30, 1927; Whitney South Sea Expedition (R. H. Beck).

ADULT MALE.—Similar to *bougainvillei*, but much darker, even somewhat darker than *vanikorensis*, but not as jet black as *samoensis*; differs from *vanikorensis* also by lacking the whitish patch on the lower abdomen and by having pure black under tail-coverts; much smaller than *bougainvillei*, but about of the size of *vanikorensis*.

SUBADULT MALE.—Much blacker than those of *vanikorensis*, particularly on the under parts; rufous brown tips and edges of feathers much darker.

♂ ad., wing 104, tail 72, culmen 24, tarsus 32; ♂ subad., wing 104, tail 71, tarsus 31.

RANGE.—Mountains of Kulambangra Island, Solomon Islands.

This isolated mountain form is distinct enough to be described even though only two specimens are known. The species has, so far, been found only on two of the four principal mountain islands of the Solomon Islands, but it surely occurs also on Guadalcanar.

A NEW NIGHTJAR FROM NEW CALEDONIA

***Eurostopodus mystacalis exul*,
new subspecies**

TYPE.—No. 337760, Amer. Mus. Nat. Hist.; ♀ ad.; Tao, northwestern New Caledonia; August 21, 1939; L. Macmillan.

Above rather light gray; feathers in central part of crown with broad black tips which merge into a black pileum; feathers on sides of crown and on nape are pale gray, lightly vermiculated with brown; central back pale gray, separated on either side by a longitudinal series of black streaks from a more brownish-gray region; scapulars much variegated, with bold whitish-

gray marks adjoining the wing; outer margins of longer scapulars with rufous gray spots on black background; uppermost throat black with pale ocher-buff margins; central throat with broader rusty buff margins, sides of throat with broad white spots; breast with a fine gray vermiculation; abdomen rather finely barred with black and rusty ocher; under tail-coverts ocher with a few narrow black-brown bars; under wing-coverts black, heavily marked with tawny rufous spots and bars; lesser upper wing-coverts brownish gray, finely vermiculated; median and greater upper wing-coverts much lighter; primary-coverts and outermost wing-

coverts blackish, with dark rufous spots; primaries blackish with two or three faint grayish-brown spots; second and third primary with a small white spot on the outer web; fourth primary with a much broader bar which continues on the inner web; secondaries blackish with irregular rufous cross bars; tertials whitish gray, with a blackish stripe along the shaft and with some black-brown vermiculation; rump, upper tail-coverts and central tail-feathers pale gray with irregular blackish bars and vermiculation; outermost three tail-feathers blackish with about twelve rather regular and well-defined bars that are pale rufous near the base and more grayish near the tip.

Differs from *mystacalis* by being much lighter above, by having a more or less solid black crown, by having only the faintest indication of a rufous collar, but principally by the color of the wing: The white areas on the outer webs of the second to fourth primary are more like bars and are not accompanied by a series of rust-colored spots, the inner webs of the primaries are solid black or show just faint rufous bars, no whitish or buff spots, except on the fourth

primary. The size is much smaller and the wing much more rounded.

Wing, 184; tail, 138.

RANGE.—Known only from the type, an adult female in egg-laying condition (weight 77 g.), collected on the coastal flats near Mount Panie.

The New Caledonian form is very different from the Australian *mystacalis*, but is clearly its representative. In view of the fact that the equally distinct Solomon Island form *nigripennis* is, generally, considered a race of *mystacalis* and that there are six other good species in the genus, it is probably best to call *exul* a subspecies of *mystacalis*. The name *mystacalis* has 3-5 months priority over *albogularis* V. and H., which was published late in 1826 or in February, 1827, not in February, 1826, as some authors have erroneously maintained.

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SEVENTEEN NEW BIRDS FROM VENEZUELA

BY WILLIAM H. PHELPS AND E. THOMAS GILLIARD

These new birds were obtained on four separate trips by the collectors of the Phelps Ornithological Collection, Caracas, as follows:

PARAGUANÁ PENINSULA.—October 10 to November 8, 1938. Publications: *Las Aves de la Península de Paraguaná*, por V. Barnés, Jr., con Anotaciones Sistemáticas por W. H. Phelps. *Bol. Soc. Ven. Cien. Nat.*, No. 46, Oct.-Dec., 1940; also Descriptions of Seven New Birds from Venezuela. By E. T. Gilliard. *Amer. Mus. Novit.* No. 1071, June 5, 1940.

COAST OF FALCÓN AND SAN LUIS MOUNTAINS.—March and April, 1940. Collectors: Dr. Ventura Barnés, Jr., A. Fernández Yépez, F. L. Benedetti and the senior author.

NORTHWESTERN VENEZUELA.—November, 1940, to April, 1941, in the States of Mérida, Táchira and Barinas. Collectors: Dr. Ventura Barnés, Jr., F. L. Benedetti, Ramón Urbano and the senior author. A month was spent in the Páramo Tamá region, of which two weeks were spent in camp on the flank of that great mountain at 2500 meters altitude. We were in the same luxuriant Temperate forest visited in 1911 by Dr. Wilfred H. Osgood and Stanley G. Jewett, of the Field Museum of Natural History. Many trips were made through this forest up to the top of the páramo at 3500 meters altitude.

SOURCES OF THE CAURA AND VENTUARI RIVERS.—November, 1940, to February, 1941. Captain Felix Cardona obtained 450 specimens from this wild region, never approached before by any collector.

We are grateful to Dr. Frank M. Chapman and Mr. John Todd Zimmer, of The American Museum of Natural History, to Mr. R. Meyer de Schauensee, of the Academy of Natural Sciences of Philadelphia, to Dr. Alexander Wetmore, of the

United States National Museum and to Mr. W. E. Clyde Todd, of the Carnegie Museum, for their valuable assistance in solving problems pertaining to this paper.

Names of colors are capitalized when direct comparisons have been made with Ridgway's "Color Standards and Color Nomenclature."

Specimens examined, unless otherwise stated, are understood to be in the collection of The American Museum of Natural History.

The alphabetical list of localities contains all of the Venezuelan place names cited in this paper. Each one has been given a number which is plotted on the accompanying map.

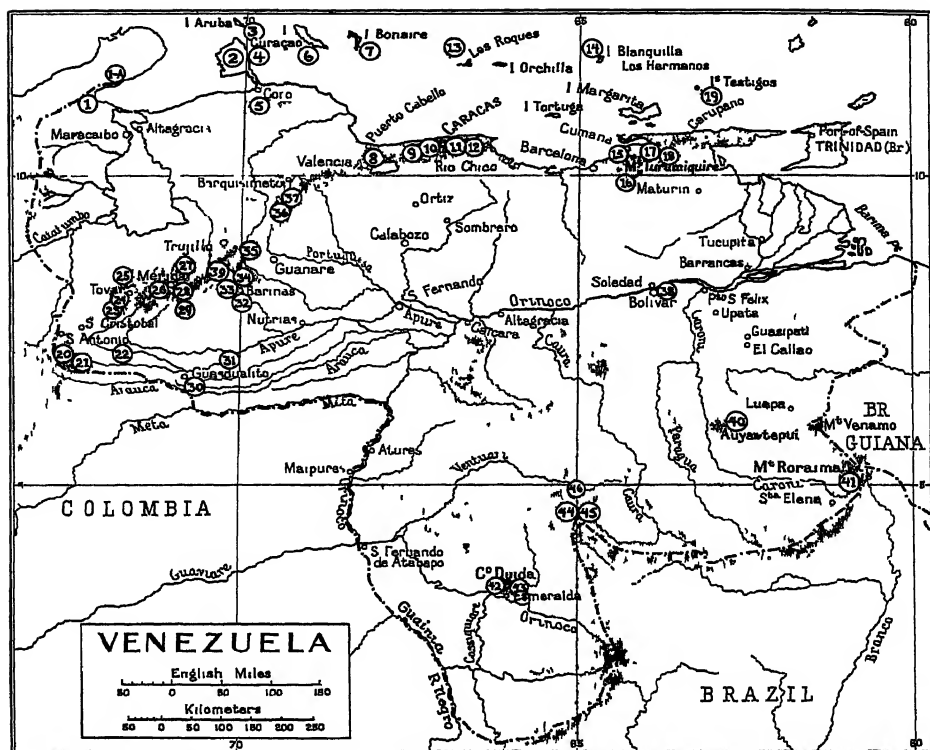
Picumnus olivaceus tachirensis, new subspecies

TYPE from Delfías, Páramo de Tamá region, State of Táchira. No. 10595, Phelps Collection, Caracas. Adult male collected February 4, 1941, by Ventura Barnés, Jr. Altitude, 2300 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *P. o. olivaceus* of central Colombia and *P. o. harterti* of southwestern Colombia and western Ecuador but backs and exposed tips of wing-coverts are darker olive, less yellowish, averaging Olive-Citrine × Saccardo's Olive, not Buffy Citrine washed with Old Gold. Yellowish-orange crown tipping of males darker than Analine Yellow tipping of *harterti*, and entirely distinct from the reddish-orange tipping of *olivaceus*. Underparts duller, more grayish citrine, less brownish, especially on chest.

RANGE.—Known only from the listed localities of the Subtropical Zone in the western part of the State of Táchira, and from Envidado, south of Medellín, Colombia.

DESCRIPTION OF TYPE.—Crown and nape black, Ochraceous-Orange × Yellow Ocher tipping on top of head, with small white spots on tips of feathers leading back over eyes to nape where they become larger and more numerous; back uniformly Olive-Citrine × Saccardo's Olive, with a yellowish tinge on the rump; base



Altamira, Barinas—34
 Aruba—3
 Barinas—32
 Barinitas—33
 Blanquilla I.—14
 Bonaire—7
 Campo Alegre—17
 Caño Seco, Mt. Duida—43
 Caripe—18
 Castilletes—1-A
 Ciudad Bolívar—38
 Colonia Tovar—9
 Cotiza—11
 Cubiro—37
 Cumbro de Valencia—8
 Curaçao—6
 Curimagua—5
 Curupao—12
 Delicias (Las Delicias)—20
 Echicera (Hechicera)—26
 El Limón—9
 El Loro (Páramo El Loro)—26
 El Valle (Valle)—26
 El Vigía—25
 Escorial—26
 Galipán—11
 Guasdalito—30
 Junquito (El Junquito)—10
 Kabadisocafía—46
 La Boca, Adicora—4
 La Culata (Culata)—26
 La Montañita, Cerro El Ávila—11
 Las Ciénegas de Avilón—11
 Las Culebrillas, Cerro El Ávila—11

Las Quiguas—8
 Los Conejos—26
 Los Dos Ríos—17
 Los Duraznos (Duraznos)—26
 Los Palmalos—17
 Los Roques Islands—13
 Maniña—45
 Mérida—26
 Montañas Sierra—28
 Mt. Auyan-tepui—40
 Mt. Bucarito—36
 Mt. Duida (Foot of)—42
 Mt. Turumiquire—16
 Nevados—28
 Palmarito—31
 Paraguaipoa—1
 Paraguaná Peninsula—2
 Páramo Misisí—35
 Páramo Mucuchies—27
 Páramo San Antonio—27
 Páramo Tamá—21
 Páramo Zumbador—23
 Philipp Camp, Mt. Roraima—41
 Quebrada Seca—15
 Queniques—23
 San Luis Mts., above San Luis—5
 Santa Bárbara, Barinas—29
 Santo Domingo—22
 Sararíña—44
 Seboruco—24
 Silla de Caracas—11
 Testigos Islands—19
 Teta de Niquitao—39
 Timotes—27
 Villa Paez—21

of upper mandible, lores, anterior malar region, and chin, grayish white, the lores with fine black tipping which becomes stronger at base of upper mandible, the chin and anterior malar region subobsoletely edged with dusky black; auriculars near Tawny-Olive faintly washed with cinnamon; sides of throat, immediately below auriculars, with a faint cinnamon wash; throat and chest dark grayish-olive, lighter on throat and at midline of chest where it is washed faintly with ochraceous buff, becoming darker on sides of chest; entire belly, abdomen and sides of these parts, pale Massicot Yellow, prominently streaked with dark olive, becoming less distinct and more grayish on inner edge of flanks; shanks dusky, tipped with grayish white; wings dark Hair Brown; secondaries narrowly margined externally with Amber Yellow; upper wing-coverts edged faintly with the back color; under wing-coverts, axillaries, and inner margins of remiges, buffy white; tail above black, the central rectrices with grayish-white inner vanes edged faintly with yellow, adjacent rectrices solid black with subobsolete whitish tips, remaining tail-feathers with irregular whitish streaking mostly on outer vanes. Bill (in life), "black"; legs and feet, "dull green"; iris, "brown." Wing, 55.5 mm.; tail, 30; exposed culmen, 11.5; culmen from base, 12.5; tarsus, 12.5.

REMARKS.—We find one specimen in the American Museum collection which is essentially similar to *tachirensis* (A. M. N. H. Cat. No. 148054). It is from Envidado, Colombia, and indicates that the range of *tachirensis* extends as far west as this town which is located ten miles south of Medellín.

Males and females are similar in size. Measurements of our series compared with 5 males and 5 females of *P. o. olivaceus* indicate that the two races are also similar in size.

SPECIMENS EXAMINED

P. o. dimotus.—NICARAGUA: San Francisco, San Carlos, San Juan River, 1 (♀).

P. o. flavotinctus.—COSTA RICA: Bornea, 1 ♂, 1 ♀; El Pozo, 2 ♂; Volcan del Oso, 1 ♀; Buenos Aires, 2 ♂, 1 ♀; Palmar, 1 ♀. PANAMA: Chiriquí, 2 ♂, 2 ♀; Tocumé, 1 ♂; Cape Garachine, E. Panamá, 1 ♂, 1 (♀); Tacarcuna, E. Panamá, 1 ♂, 1 ♀; El Real, E. Panamá, 1 ♂, 1 (♀); Tapaliza, E. Panamá, 1 (♀); Panamá, 1 ♂, 1 ♀.

P. o. tachirensis.—VENEZUELA (Phelps Collection): Delicias, Páramo de Tamá region, 1 ♂ (type) (2300 m.), 1 ♀ (2300 m.); Villa Paéz, Páramo de Tamá region, 1 ♂ (2080 m.), 1 ♀ (2200 m.); Queniquea, Táchira, 1 ♂ (1600 m.) 1 ♀ (1600 m.).

P. o. olivaceus.—COLOMBIA: Bogotá, 2 ♂, 1 (♀); "Bogotá," 11 (♀); Honda, 4 ♂, 2 ♀; Huila, 1 ♂, 3 ♀; Río Toche, Tolima, 1 ♂, 1 ♀; La Frijolera, Antioquia, 1 ♂; Malena, Antioquia, 1 ♂; Puerto Berrio, 1 ♂.

P. o. harterti.—COLOMBIA: Baibacoas, Mariño, W. Colombia, 1 (♀); Río de Oro, W. Colombia, 1 ♀. ECUADOR: Paramba, 1 ♂ (type), 2 ♀; Esmeraldas, 2 ♂, 2 ♀; Chimbo, 2 ♂, 1 (♀); Santa Rosa, 1 ♀; La Chonta, 1 ♂, Santo Domingo, 1 ♂; Mindo, 1 ♀, Cebollal, 1 ♂; W. Ecuador, 2 ♂; N. Ecuador, 1 ♂.

P. granadensis granadensis.—COLOMBIA. San Isidro, W. Colombia, 2 (♀); Media Luna, W. Colombia, 2 ♀; Primavera, W. Colombia, 1 ♂; R. Dagua, 2 ♂; San Antonio, Cauca, 1 ♂, 2 (♀); Gallera, Cauca, 1 (♀); Salento, Cauca, 1 ♂; Los Cisneros, 1 ♂, 1 ♀; Río Frio, Cauca, 1 ♂; Río Cauquita, 1 ♂.

P. g. antioquiensis.—COLOMBIA: Peque, Antioquia, 1 ♂ (type), 1 ♀; Antioquia, 1 (♀).

Asthenes wyatti mucuchiesi, new subspecies

TYPE from Páramo Mucuchies, State of Mérida. No. 14168, Phelps Collection, Caracas. Adult male collected September 14, 1941, by F. Benedetti. Altitude, 3800 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *A. u. wyatti*, known from the Páramo de Pamplona and Santa Marta Mountains in Colombia, but upperparts in general decidedly less brownish with grayer, less brownish, edgings on crown and back; central shaft-streaks on back darker, brownish black instead of dark brown; outer rectrices with blackish edgings on basal halves of inner vanes, not solid cinnamon-brown. Upper tail-coverts light olivaceous-gray as against brown with buff-brown edgings; outer primary, on basal portion of inner vane (underside), with a broad light vinaceous-brown edge, not solid glossy-grayish with subobsolete vinaceous edging.

RANGE.—Known only from the type locality in the Páramo Zone of the Andes of Mérida.

DESCRIPTION OF TYPE.—Crown light grayish-olive with brownish-black shaft-streaks, more profuse on forehead, becoming less definite and narrower on nape, giving this area a lighter appearance; a narrow superciliary streak, extending from base of upper mandible to supra-auriculars, near Pinkish Buff, a little lighter in front of eye; lores buffy with fine blackish tips; post-loral area dusky brown; auriculars light buff, tinted with rufous, with dusky-brown edgings; malar region buffy white with narrow dusky edging; back with edgings a little more brownish than crown, with broad conspicuous brownish-black shaft-streaks; rump lighter, a little more brownish than back with dark shaft-streaks obsolete; upper tail-coverts light olivaceous-gray with lighter grayish edgings. Chin dull white; throat gray, with an Ochraceous-Tawny

spot speckled finely with black, about 7 mm. in diameter; chest light brownish-gray with inconspicuous narrow light buff shaft-streaks, becoming darker, more brownish, on sides of chest; anterior breast like chest; posterior breast and abdomen lighter than Pinkish Buff, sides of those parts washed heavily with light olive-brown, especially on sides of abdomen; shanks like sides of abdomen; under tail-coverts light buffy-brown. Remiges dark brown; primaries with outer edgings on basal halves cinnamon brown, except second and third which are dusky black with buffy-brown edging, the remainder of primaries with this part cinnamon brown speckled with black and with faintly lighter, more buffy, edgings; secondaries with outer edgings on basal halves bright Tawny; tertiaries like secondaries but with a dusky-black fringing, innermost tertial with a cinnamon-brown basal shaft-streak; outer halves of outer vanes of primaries, secondaries and tertiaries buffy brown, becoming broader and darker on tertiaries, narrow or obsolete on primaries; wing-coverts, on exposed surfaces, a little more rufous than Sudan Brown, with dusky-black feather centers, subobsolete on lesser coverts; primary coverts blackish brown with narrow Sudan Brown outer edgings; under wing-coverts and axillaries Ochraceous-Tawny; basal halves of inner vanes of primaries and secondaries light vinaceous brown, restricted to basal third on outermost primary; tertiaries with narrow light olivaceous-brown edgings. Tail above: central pair of rectrices dusky black with light buffy outer edgings becoming more chestnut on basal halves, the inner edgings narrower and without chestnut; outer three rectrices pale Tawny on both vanes, with broad dusky-black edgings on basal halves of inner vanes, the outer edges with a subobsolete buffy edge; fourth and fifth rectrices from outside dusky black with pale tawny edges and tips. Bill (in life): upper mandible, "black," lower mandible, "flesh, with black tip"; legs and feet, "black"; iris, "brown." Wing, 60 mm.; tail, 74; exposed culmen, 15.5; culmen from base, 19.5; tarsus, 22.5.

REMARKS.—Males and females appear to be similar in coloration and size. The range of measurement of six males is as follows: wing, 60–63 mm.; tail, 67.5–74; exposed culmen, 14.5–15.5; culmen from base, 18–19.5; tarsus, 22.5–23. Our single female measures: wing, 61 mm.; tail, 69.5; exposed culmen, 14; culmen from base, 17; tarsus, 22.

We have not seen the type of *wyatti*, nor topotypical specimens from Páramo de Pamplona, Colombia, but Hellmayr¹ says: "The type specimen differs from those of the Santa Marta range by deeper under-

parts and much paler (buff instead of deep ochraceous) throat patch. Whether this divergency is individual or racial remains to be determined by a series from Santander." The difference in throat patch would appear to be individual variation as our series of *mucuchiesi* shows it ranges from grayish white to Ochraceous-Tawny.

SPECIMENS EXAMINED

A. w. mucuchiesi.—VENEZUELA (Phelps Collection): Páramo Mucuchies (3800–3850 meters), 6 ♂ (inc. type), 1 ♀. VENEZUELA (Carnegie Museum): Teta de Niquitao, Trujillo, 1 ♂.

A. w. wyatti.—COLOMBIA: Páramo de Chiriqua, Sierra Nevada de Santa Marta, 1 ♂, 1 ♀. COLOMBIA (Carnegie Museum): Carro de Caracas, 2 ♀; Páramo de Mamarongo, 3 ♂, 2 ♀; Páramo de Chiriqua, 4 ♂, 6 ♀, 1 (?); Macatoma, 1 ♂.

A. w. aequatorialis.—ECUADOR: Mt. Chimborazo, 3 ♂ (inc. type); 2 ♀; Quito, 1 (?).

A. w. azuay.—ECUADOR: Bestion, Río Shingata, Prov. de Azuay, 1 ♂ (type).

A. w. gramicola.—PERU: Oroya, Río Mantara, 1 ♀; Tirapata, Titicaca Basin, 1 ♂.

Phylidor ruficaudatus flavipectus, new subspecies

TYPE from Maníña, Río Enecuni, which falls into the upper Río Merevari (source of the Caura River), State of Bolívar. No. 12756, Phelps Collection, Caracas. Adult male, collected January 15, 1941, by Captain Felix Cardona. Altitude, 700 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Similar to *P. ruficaudatus* but less grayish below, with a bright yellowish wash on underparts, especially throat which is brightly washed with Mustard Yellow instead of pale Straw Yellow. Under wing-coverts and axillaries more ochraceous, less buffy. Sides of chest and flanks more yellowish olive, less grayish olive.

RANGE.—Known only from the listed localities at the sources of the Caura and Ventuari Rivers, and from Mt. Auyan-tepui, in the Tropical Zone.

DESCRIPTION OF TYPE.—Crown dark greenish-olive faintly tinted with yellow, each feather with a narrow gray shaft-streak and a subobsolete dusky edging, becoming lighter, more yellowish, at base of upper mandible; hind neck and back Dark Citrine becoming brighter, more Orange-Citrine, on lower back, rump and upper tail-coverts; lores buffy with fine black tips; supra-loral margin, eye-ring, malar region and superciliary streak (leading from over eye to post-auriculars) bright Mustard Yellow; lower half of auriculars light yellowish with subobsolete dusky edgings, upper half dark brownish-olive with narrow light buff shaft-streaks; throat washed with Mustard Yellow; chest

¹ 1935, Field Mus. Nat. Hist., Zool. Ser., XIII, Pt. 4, p. 147.

slightly less brilliant than throat with yellowish olive-buff streakings; breast and abdomen like chest; sides of chest and flanks Dark Olive-Buff, darkest on inner edges; shanks like inner flanks; under tail-coverts brownish buff, with lighter buff centers, tipped faintly with rufous; under wing-coverts Light Ochraceous-Buff, more yellowish on wrist; axillaries and inner edges of primaries and secondaries Warm Buff, becoming more ochraceous toward body; exposed parts of upper wing-coverts Saccardo's Olive with dusky subterminal central streaks; primaries above dusky black (with inner edgings as described for underside) with brownish-olive outer edges; secondaries like primaries but outer vanes almost completely brownish olive; exposed tertials solid brownish olive; tail above Tawny X Russet; tail below slightly paler, less reddish than upper surface. Bill (in life), "brown"; feet, "brown." Wing, 92 mm.; tail, 75; exposed culmen, 16.5; culmen from base, 20; tarsus, 20.5.

REMARKS.—As the typical form has only been recorded in Venezuela from the Duida region, our new race extends the range of the species toward the northwest. The localities listed are names of Indian villages. The new race is similar in size to *ruficaudatus*. The females have shorter wings and tails:

P. r. ruficaudatus

Wing 5 ♂	90.5-96.5	Av. 92.8
5 ♀	80.5-85.5	Av. 82.8
Tail 5 ♂	68.5-72.5	Av. 70.8
5 ♀	62.0-67.0	Av. 64.5

SPECIMENS EXAMINED

P. r. ruficaudatus.—BOLIVIA: Mission San Antonio, R. Chimore, Cochabamba, 1 ♂. PERU: Tavera R., 1 ♀; Candamo, 1 ♂; Río Seco, W. of Moyobamba, 2 ♂; Lagarto, Alto Ucayali, 3 ♂, 1 ♀. ECUADOR: San José Abajo, 1 ♂, 2 ♀; Arolidona Arriba, 1 ♀; Boca R., Curaray, 1 ♂, 1 ♀; Río Suno, above Avila, 4 ♂, 2 ♀; Río Suno Abajo, 1 ♀; Napo, E. Ecuador, 5. COLOMBIA: "Bogotá," 4; Colombia, 1. BRAZIL: Matto Grosso, 1 ♂; Rio Guamá, Sta. Maria de San Miguel, 1 ♂. FRENCH GUAYANA: Approuage, 1 ♂. VENEZUELA: Foot of Mt. Duida, 1 ♂; Caño Seco, Mt. Duida, 1 ♀.

P. r. flavipectus.—VENEZUELA: Mt. Auyan-tepui, 1 (?) (460 m.). VENEZUELA (Phelps Collection): Maniña, source of Merevari R. (Upper Caura R.), 1 ♂ (type) (700 m.), 1 ♀ (700 m.), 2 (?) (700 m.); Saraiña, source of Merevari R. (Upper Caura R.), 1 ♀ (760 m.); Kabadisocafía, source of Ventuari R., 1 (?) (550 m.).

Ramphotrigon megacephala venezuelensis, new subspecies

TYPE from Ciudad Bolivia, Barinas. No. 12479. Phelps Collection, Caracas. Adult male collected April 4, 1941, by Ventura Barnés, Jr. Altitude, 150 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Near to *R. m. boliviana* of northern Bolivia, but distinguishable by having crown more greenish, less dusky; back brighter greenish; chest-band lighter, more yellowish olive, less brownish olive; abdomen and lower flanks brighter, more citron yellow. Size similar.

RANGE.—Known only from the type locality in the Tropical Zone of the upper Apure Valley.

DESCRIPTION OF TYPE.—Head Krönberg's Green with dusky-olive central areas on exposed surface, forming indistinct mottling; back near Yellowish Olive, becoming a trifle more brownish on lower rump; superciliary streak terminating over post-ocular area, near Colonial Buff, with dusky tipping above lores; lores dark brownish; a light lunule below the eye, slightly more pallid than superciliary streak; auriculars like back with basal halves buffy yellow; chin ashy with faint yellowish tips; throat light, with an amber-yellow wash; chest brownish Olive-Buff with the feather margins approaching Mustard Yellow; sides of chest Dull Citrine with a yellowish wash; abdomen, posterior flanks and under tail-coverts, near Barium Yellow; shanks Saccardo's Olive with faintly more yellowish tips. Remiges a little lighter than Chaetura Drab; primaries with outer margins narrowly Deep Olive-Buff (except on outer halves where this lighter edging becomes obsolete); secondaries with outer margins broader and lighter, closer to Colonial Buff; tertial margins broader still, becoming paler, more ashy, on innermost; upper wing-coverts Chaetura Drab; lesser series with yellowish-olive tipping; middle and greater series with large pale Chamois tips forming two conspicuous wing-bands; under wing-coverts and axillaries pale yellowish-white, washed with Chamois on wrist and on inner axillaries; inner edgings of remiges Cream Color. Tail a little lighter than Olive-Brown with outer edges approaching bright Olive-Buff, becoming paler, more grayish brown, on outer rectrices. Bill (in life), "black"; legs, "black"; iris "brown." Wing, 64 mm.; tail, 56.5; exposed culmen, 12; culmen from base, 15; tarsus, 16.

SPECIMENS EXAMINED

R. m. venezuelensis.—VENEZUELA (Phelps Collection): Ciudad Bolivia, Barinas (150 m.), 4 ♂ (inc. type).

R. m. megacephala.—BRAZIL: Minas Gerais, Pico de Bandeira, 1 ♂. ARGENTINA: Puerto Segundo, 1 (?).

R. m. boliviana.—BOLIVIA: Misión San Antonio, 2 ♂ (inc. type), 1 ♀.

Mecocerculus stictopterus albocaudatus,
new subspecies

TYPE from Páramo Zumbador, Táchira. No. 9422, Phelps Collection, Caracas. Adult male collected November 16, 1940, by Ventura Barnés, Jr. Altitude, 2600 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *M. s. stictopterus* but differing most noticeably by having entire outer pair of rectrices, and inner vanes of second and third pairs, dull buffy-white instead of light hair-brown; axillaries, under wing-coverts, inner edges of secondaries, more strongly lemon-yellow, less grayish white; flanks, abdomen and under tail-coverts with a richer yellowish wash.

RANGE.—Known only from the upper Subtropical Zone at Páramo Zumbador, Táchira, and from Queniquea, lower down on the same mountain.

DESCRIPTION OF TYPE.—Top of head light neutral gray; superciliary streak from nasal feathering to post-auriculars, grayish white; lores Dark Mouse Gray, darker than crown; auriculars light grayish-olive; malar region dull gray with dusky subterminal areas showing through along upper edge; back olive citrine with a faint yellowish tint becoming stronger on rump; upper tail-coverts brownish olive; throat, chest and sides of chest, Pallid Neutral Gray with scattered whitish reflections; upper abdomen white with concealed grayish areas showing through faintly; flanks grayish white washed strongly with Marguerite Yellow; shanks grayish white; abdomen and under tail-coverts washed with Marguerite Yellow. Remiges Chaetura Drab; primaries except on first, with fine buffy outer margins; secondaries with outer margins broader and more buffy ochraceous; tertials with narrow outer margins buffy yellow except on innermost which has a broad outer margin; lesser upper wing-coverts like central back; median and greater coverts like primaries with broad tips, near Pale Olive-Buff, forming two well-defined wing-bars; under wing-coverts white, tinted strongly with Marguerite Yellow especially on wrist; primaries and secondaries below glossy Mouse Gray with inner edgings white with a trace of yellowish wash. Tail above, light mouse-gray with yellowish citrine outer edgings, fading away on outer halves of feathers, except as follows: outer rectrices solid dull white; inner vanes of second rectrices from outside also solid dull white except for narrow grayish areas at tips; inner vanes of third pair of rectrices on basal halves dull grayish-white; tail below with markings as described for the upper surface but with a suggestion of yellow with the white. Bill (in life), "black"; legs, "gray"; iris, "brown." Wing, 66.5 mm.; tail, 62; exposed culmen, 10; culmen from base, 12.5; tarsus, 18.

REMARKS.—Hellmayr¹ gives the range

of *stictopterus* as the Temperate Zone of Colombia (except the Santa Marta Mountains), Ecuador and Mérida in Venezuela. This Venezuelan locality is based on a single specimen recorded by Slater.² If this Mérida specimen really is *stictopterus*, and not *albocaudatus*, then our new form occurs within the extremities of the range of *stictopterus*, as Páramo Zumbador (type locality of *albocaudatus*) is situated on the ridge of the Venezuelan Andes between Mérida and the Colombian frontier. This would be an unusual distribution, perhaps an indication that *albocaudatus* might be specifically distinct.

SPECIMENS EXAMINED

M. s. albocaudatus.—VENEZUELA (Phelps Collection): Páramo Zumbador (2600–2680 m.), 2 ♂ (inc. type), 4 ♀, 1 (?) ; Queniquea (1900 m.), 1 ♂.

M. s. stictopterus.—COLOMBIA: "Bogotá," 5 (?) ; Laguneta, 3 ♂ ; Santa Isabel, 1 ♂, 1 ♀ ; Almaguer, 1 ♂ ; coast range west of Popayán, 1 ♂. ECUADOR: "Ecuador," 2 (?) (inc. type of *alutus*) ; Pichincha, 2 ♂, 2 ♀ ; above San Gabriel, 1 ♀ ; upper Sumaco, 2 ♀ ; above Baeza, 1 ♂ ; Oyacachi, 1 ♂, 4 ♀ ; Urbina, 1 ♂ ; Corazón, 1 ♂, 1 ♀ ; Papallacta, 2 ♂, 3 ♀ ; Tambillo, 1 (?) ; Salvia, 2 ♂ ; Taraguacocha, 2 ♂, 2 ♀ ; Guachanamá, 1 ♀. PERU: Leimebamba, 1 ♂ ; San Pedro, South of Chachapoyas, 3 ♂, 1 ♀, 1 (?) ; La Lejía, 2 ♂, 3 ♀ ; Taulis, 2 ♂, 2 ♀ ; Chugur, 2 ♂, 1 ♀ ; El Tambo, 1 ♂, 1 ♀, 1 (?) .

M. s. taeniopterus.—PERU: Ramicruz, 2 ♂ ; Tocopqueu, Occobamba Valley, 1 ♀.

M. poecilocercus.—ECUADOR: San Bartolo, Alamor Range, Prov. de Loja, 1 ♂ ; Celica, Prov. de Loja, 1 ♀.

M. hellmayri.—BOLIVIA: Incahaca, Prov. Cochabamba, 1 ♂, 1 ♀.

M. colopterus.—ECUADOR: Chimbo, 1 ♀ ; Punta Sta. Ana, Prov. del Oro, 1 ♂.

M. minor.—COLOMBIA: "Bogotá," 2 (?) .

Mecocerculus leucophrys tachirensis,
new subspecies

TYPE from Queniquea, Táchira. No. 9167, Phelps Collection, Caracas. Adult female collected November 10, 1940, by F. Benedetti. Altitude, 1900 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *M. l. nigriceps* of the coast mountains of Venezuela from Mérida to Sucre but darker above, more dusky olivaceous, not brownish olive; wing-bands averaging dull

¹ 1927, Cat. Birds Amer., XII, p. 397.

² 1888, Cat. Birds Brit. Mus., XIV, p. 28.

white instead of buffy ochraceous-white. Size similar.

RANGE.—Known only from the Subtropical Zone at Queniquea, Táchira.

DESCRIPTION OF TYPE.—Top of head dusky Chaetura Drab; nasal feathering, and a narrow superciliary streak terminating over the eye, grayish white, the former with dark edging; back dusky olive passing into brownish olive on upper tail-coverts; a dusky spot in front of eye; auriculars dull grayish-white; post-ocular area like crown; throat dull white; chest gray with a few white streakings at midline; breast and abdomen pale Naphthalene Yellow; under tail-coverts white, faintly tinted with yellowish; shanks grayish white with subterminal brownish areas. Remiges Chaetura Black; primaries, excepting first two, with outer margins narrowly pale brownish-buff; secondaries with broader outer margins of pale Massicot Yellow; tertiaries with outer margins and tips dull white; lesser upper wing-coverts like the back; median and greater series dark brownish-black with broad terminal spots averaging dull white (these spots with some traces of light buff), forming two conspicuous wing-bars; under wing-coverts and axillaries grayish white washed with Marguerite Yellow, slightly richer on bend of wing; inner edges of remiges dull buffy-white. Tail dark hair-brown with outer margins of rectrices near Grayish Olive, except outer pair which are grayish. Bill (in life), "black"; legs, "black"; iris, "dark brown." Wing, 61.5 mm.; tail, 62.5; exposed culmen, 10; culmen from base, 13; tarsus, 19.

SPECIMENS EXAMINED

M. l. leucophrys.—BOLIVIA: Incachaca, Cochabamba, 1 ♀; California, Santa Cruz, 1 ♂. *M. l. brunneomarginata*.—PERU: Cedrobamba, 1 ♂ (type), 1 ♀.

M. l. rufomarginatus.—ECUADOR: Pichincha, 1 ♂, 1 ♀; Quito Valley, 1 (?) (type).

M. l. notatus.—COLOMBIA: Paramillo, 1 ♂; Laguneta, 1 ♀.

M. l. setophagoides.—COLOMBIA: El Piñon, 3 ♂, 2 (?); Fomeque, 1 (?); Subia, 1 ♂; Tocaimito, 1 ♂, 1 ♀; La Porquera, 2 ♂; Chipaque, 6 ♂, 7 ♀; "Bogotá," 11 (?); La Pafuella, near Facataziva, 1 ♀.

M. l. tachirensis.—VENEZUELA (Phelps Collection): Queniquea, Táchira (1900 m.), 1 ♀ (type), 2 (?).

M. l. nigriceps.—VENEZUELA: Carapas, 2 ♂, 2 ♀; Mt. Turumiquire, 1 ♂; Galipán, Cerro del Ávila, 5 ♂, 4 ♀; Las Cienegas de Ávila, Cerro del Ávila, 1 ♂, 1 ♀; Junquito, near Caracas, 1 ♂, 2 ♀, 1 (?); Colonia Tovar, 2 ♂, 1 (?); Cumbre de Valencia, 2 ♂; Mt. Bucarito, near Tucuy, 1 (?); La Culata, Mérida, 1 ♂, 1 (?); El Valle, Mérida, 1 ♂, 1 ♀, 1 (?); Los Conejos, Mérida, 1 ♂; Escorial, Mérida, 1 ♂, 1 (?).

M. l. roraimae.—VENEZUELA: Philipp Camp, Mt. Roraima, 1 ♂, 1 ♀.

Machaeropterus regulus obscuristriatus, new subspecies

TYPE from El Vigía, Mérida. No. 9810, Phelps Collection, Caracas. Adult male collected November 26, 1940, by W. H. Phelps. Altitude, 200 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *M. r. striolatus* of the upper Apure Valley in Venezuela, southeastern Colombia, eastern Ecuador and northeastern Peru, but lateral striping on feather edgings of breast, abdomen and flanks decidedly darker, less Russet, more Mars Brown, especially on central abdomen, with the whitish shaft-streaks averaging broader, giving more contrast; lower rump and upper tail-coverts much brighter, washed with Orange-Citrine instead of light Warbler Green. Size similar.

RANGE.—Known only from the type locality in the lowlands of the Lake Maracaibo basin, at the base of the Mérida Andes.

DESCRIPTION OF TYPE.—Top of head, from base of bill to central nape, with a brilliant cap a little richer than Spectrum Red, with the bases of the feathers glossy white; lores, superciliary streak and auriculars near Yellowish Olive, the auriculars with a faintly darker hue; malar region like sides of face but becoming slightly lighter, more buffy-gray, near lower edge, with a small light buffy-olive tint just behind gape; back and shoulders Warbler Green becoming brighter on rump and upper tail-coverts, where it is washed with Orange-Citrine. Chin and throat light grayish-brown (several tones lighter than Avellaneous), becoming lighter gray-white at lower edge of throat; chest stained brightly with Nopal Red intermingled with a few subobsolete stains of Chalcidony Yellow, becoming predominantly green, like posterior malar region. at sides of chest: breasts, flanks, abdomen and under tail-coverts dull white with dark brown edgings about half of the width of the feather vanes, giving the appearance of long slender striping, becoming Mars Brown on lower central abdomen and under tail-coverts while on flanks and upper breast it is lighter, more Cinnamon-Brown, the inner tipplings of flanks and sides of abdomen with a few subobsolete tints of light citrine; exposed surfaces of shanks a little darker than Ochraceous-Tawney. Remiges dusky black; primaries with narrow light Oil Green outer edgings, except on first two which are largely solid dusky black; secondaries with broader slightly darker edgings (except on innermost where greenish edging is subobsolete, replaced with dusky gray) and strong oval hypertrophied shafts, most pronounced on last three feathers (these slightly curved, rigid shafts taper abruptly to thin flexible shafts about 4 mm. from the tips), the three innermost secondaries with dusky tipping on inner vanes, broadest on innermost; tertiaries with dusky gray-green tips and outer edgings; wing-coverts a little darker green than upper back; primary coverts dusky black with outer edges Dark Greenish Olive; under wing-coverts white

becoming green, like auriculars, on wrist; axillaries white with pale brownish tipping; inner edges of remiges glossy white; tail Deep Mouse Gray with traces of greenish on outer edges; tail below pale gray with ivory-white shafts and whitish inner edgings, except on central pair of rectrices. Bill (in life), "brown"; legs, "olive"; iris, "orange." Wing, 50.5 mm.; tail, 20.5; exposed culmen, 8; culmen from base, 10; tarsus, 14.

SPECIMENS EXAMINED

M. r. regulus.—BRAZIL: Bahia, 10 ♂, 1 ♀; Rio Janeiro, 1 ♂; "Brazil," 2 ♂.

M. r. striolatus.—ECUADOR: Zamora, Prov. de Loja, 2 ♂, 1 ♀; near Quito, 3 ♂, 1 ♀; Napo, E. Ecuador, 1 ♂; San José Abajo, 2 ♀; below San José de Sumaco, E. Ecuador, 1 ♂, 1 ♀; Rio Suno, above Avila, E. Ecuador, 1 ♀; Rio Suno Abajo, 1 ♂; Boca del Río Curaray, 1 ♂. COLOMBIA: Florencia, Caquetá, 3 ♂, 2 ♀. VENEZUELA (Phelps Collection): Barinitas, Barinas, 3 ♂.

M. r. antioquiaae.—COLOMBIA: Honda, Tolima, 10 ♂, 2 (?); Primavera, W. Colombia, 2 ♂; La Frijolera, Antioquia, 1 ♂, 1 (?); alto Bonito, Antioquia, 1 ♀; "Bogotá," 1 ♂; Pto. Valdivia, Antioquia, 1 ♂ (type), 1 ♀.

M. r. obscuroides.—VENEZUELA (Phelps Collection): El Vigía, Mérida, 3 ♂, 1 ♀ juv.

***Machaeropterus regulus aureopectus*,
new subspecies**

TYPE from Kabadisocafá, near source of Ventuari River. No. 12847, Phelps Collection, Caracas. Adult male collected December 12, 1940, by Captain Felix Cardona. Altitude, 550 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *M. r. obscuroides* of the State of Mérida on the lowlands south of Lake Maracaibo, but chest with a vivid Wax Yellow band, instead of Nopal Red staining intermingled with a few obsolete stains of Chalcidony Yellow; throat uniform grayish white suddenly changing to Roman Green at sides, instead of throat dull grayish-brown merging gradually to Yellowish Olive; sides of head darker green and with a little Wax Yellow horn-like plume in the superciliary streak just over the front of each eye, which may, or may not, prove to be constant; bases of pileum feathers white with a yellowish tint, strongest on forehead, not white rarely tinted with pale citrine; back darker, Warbler Green × Olive-Green instead of light Warbler Green; rump and upper tail-coverts Warbler Green just a tint lighter than back, instead of brightly washed with Orange-Citrine. Size similar.

RANGE.—Known only from the type specimen from near the source of the Ventuari River, from southern Venezuela, in the State of Bolívar, 32 miles from the Brazilian frontier.

DESCRIPTION OF TYPE.—Top of head, from base of bill to central nape, with a brilliant cap

near Spectrum Red, with bases of feathers white tinted with yellow, strongest on forehead; lores, superciliary streaks, auriculars and sides of neck dark Roman Green; two "horn-like" Wax Yellow plumes in superciliary streaks over front of eyes; malar region like sides of head with a faint buffy brown wash at posterior gape, becoming a trifle more ashy brown at junction of throat; back and shoulders Warbler Green × Olive-Green becoming slightly lighter, Warbler Green, on rump and upper tail-coverts. Chin Ashy-White with subobsolete brownish tipping; throat pale buffy ash-white becoming lighter, more dull white at lower edge; chest with a vivid Wax Yellow band approximately 10 mm. wide, continuing around sides of chest to inner shoulders; breast, flanks and abdomen dull white with dark brown edgings about half of the width of the feather vanes, giving the appearance of long slender Mars Brown striping, this striping on inner tipplings of flanks and sides of abdomen lighter, more Ochraceous-Tawny, with a few subobsolete yellowish-citrine tints; exposed surfaces of shanks near Buckthorn Brown; under tail-coverts nearly solid dark Clay Brown, with a few subobsolete whitish spots. Remiges dusky black; primaries with narrow light Oil Green outer edgings, except on first two which are largely solid dusky black; secondaries with broader slightly darker edgings (except on three innermost where the greenish edgings are obsolete, replaced with dusky gray) and strong oval hypertrophied shafts becoming more rigid inwardly, tapering to thin flexible shafts about 4 mm. from tips of feathers; tertials small and weak with dusky green outer edgings and broad dusky tips like innermost pair of secondaries; lesser and median wing-coverts like back; greater coverts dusky black with Oil Green outer vanes; bastard wing solid dusky black; primary coverts with outer edgings a tone darker than edging of primaries; under wing-coverts white stained with Cinnamon-Buff, becoming greenish on shoulder; axillaries white stained with Cinnamon-Buff; inner edges of remiges glossy white; tail dark Mouse Gray with a subobsolete indication of olive on outer vanes; tail below pale gray with strong ivory-white shafts and whitish inner edgings, except on central pair of rectrices. Bill (in dried skin): upper mandible, Chaetura Black, lower mandible, near Drab; feet (in dried skin), Tawny-Olive. Wing, 49.5 mm.; tail, 19.5; exposed culmen, 8; culmen from base, 10; tarsus, 14.5.

REMARKS.—The species does not seem to have been previously recorded from Venezuela, the known races coming no nearer than southern Brazil (*regulus*), southeastern Colombia (*striolatus*) and Antioquia, Colombia (*antioquiaae*). In 1939 *striolatus* was found in the upper Apure Valley, and in 1940 the new forms *obscuristriatus* and

aureopectus in northwest and southeast Venezuela, respectively.

SPECIMENS EXAMINED

M. r. aureopectus.—VENEZUELA (Phelps Collection): Kabadisocaña, source of Ventuari R., 1 ♂ (type).

Other specimens, as listed for *M. r. obscuristriatus*.

Laniisoma elegans venezuelensis, new subspecies

TYPE from Santa Bárbara, State of Barinas. No. 12183, Phelps Collection, Caracas. Adult male collected March 26, 1941, by Ventura Barnés, Jr. Altitude, 200 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Similar to the unique type of *L. cadwaladeri* from Bolivia, but sides of forehead lighter, lemon-yellow similar to underparts, instead of orange contrasting with underparts; back slightly brighter green, more yellowish; sides, flanks and under tail-coverts less heavily barred; bill more slender, less deep, depth of culmen at nostrils 3.5 mm. against 4.5; basal halves of back feathers lighter, Pale Neutral Gray, instead of dark gray; wing shorter, 96.5 mm. against 102; tail shorter, 54.5 against 59.5.

RANGE.—Known only from the type specimen from the lowlands of the upper Apure Valley, at the base of the Mérida Andes.

DESCRIPTION OF TYPE.—Crown and nape black with subobsolete dark brownish tippings; post-nasal areas Wax Yellow with blackish tips; lores black; a thin faint blackish-olive superciliary streak running from front of eye to supra-auriculars, subobsolete over orbit; post-orbital area dusky olive; auriculars a little more yellowish with subobsolete blackish tips; back Yellowish Oil Green × Calla Green, with subobsolete blackish tipping, becoming a bit lighter on upper tail-coverts; chin narrowly pale yellow; throat and lower malar region bright Lemon Chrome, with a faint orange wash on sides of throat and lower malar parts, several of the feathers on malar region with fine terminal bars; chest at midline like throat, becoming slightly darker, more olivaceous Lemon Yellow on sides of chest, with inconspicuous blackish subterminal barring and spotting on inner feathers (those which cover wrist in folded wing position); breast and abdomen Lemon Yellow with a wash of Lemon Chrome; flanks and sides of abdomen Lemon Yellow, becoming more olivaceous Lemon Yellow inwardly, inner edge of feathers with two inconspicuous bars each; under tail-coverts pale Picie Yellow with blackish bars and spots on outer halves; shanks light yellowish with pronounced dusky barring. Remiges dark brownish-black; primaries with narrow Olive Green edgings, becoming dull brownish on outer halves, outermost solid dark brownish-black; second-

aries with broader Olive Green outer edgings; tertials with outer halves of both vanes light Olive Green, inner vanes on basal halves tending to light dusky-olivaceous; lesser and medium wing-coverts a little darker than the back; greater coverts with olive-green (similar to other coverts) restricted to outer vanes, inner vanes being dusky black; bastard wing and primary coverts dusky black with outer edges subobsolete olivaceous; under wing-coverts and axillaries near Barium Yellow, brighter at tips, the wrist more Strontian Yellow; inner edges of remiges pale buffy-white. Tail dusky black, with outer vanes Olive Green except central pair of rectrices which are dark Olive Green, outermost ones with inner vanes lighter, more Mouse Gray. Bill (in life): upper mandible, "black," lower mandible, "horn"; legs, "plumbeous"; iris, "brown." Wing, 96.5 mm.; tail, 54.5; exposed culmen, 16; culmen from base, 19; depth of culmen at nostrils, 3.5; tarsus, 19.

REMARKS.—We cannot see any specific differences between our new bird from Venezuela and *elegans* from southeastern Brazil. Inasmuch as our specimen much more closely resembles *cadwaladeri* than *elegans*, it follows that the former would also be a subspecies of *elegans*.

We call attention to two females and two nestlings, from Ecuador, the only known specimens of *L. buckleyi*. Not until a male of *buckleyi* is collected can it be determined whether it is really of specific rank, whether it is a subspecies of *elegans*, or whether *cadwaladeri* or *venezuelensis* are synonymous with it. The range of *buckleyi* is intermediate between that of *cadwaladeri* and that of *venezuelensis*.

SPECIMENS EXAMINED

L. e. elegans.—BRAZIL: "Brazil," 1 ♂, 1 ♀, 1 (?); Rio de Janeiro, 1 (?); Bahia, 1 (?).

L. e. cadwaladeri.—BOLIVIA (Acad. Nat. Sci. Phila.): Sta. Ana, Río Coroica, Dept. La Paz, 2000 ft., 1 ♂ (type).

L. e. venezuelensis.—VENEZUELA (Phelps Collection): Santa Bárbara, State of Barinas, 1 ♂ (type).

Thryothorus mystacalis tachirensis, new subspecies

TYPE from Villa Paez, Páramo Tamá region, State of Táchira. No. 10901, Phelps Collection, Caracas. Adult male collected February 14, 1941, by Riera. Altitude 2060 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *T. m. consobrinus* but crown and nape decidedly darker, more dusky olive, especially crown, less dull olive-brown; tail darker throughout, but especially the light bars

which are near dull olivaceous Snuff Brown instead of bright Sayal Brown; upper tail-coverts darker, more dark Snuff Brown, less Mikado Brown; under tail-coverts darker, Buckthorn Brown instead of bright brownish-buff; throat white instead of buffy white; sides of neck and chest band darker, with a grayish instead of a brownish wash; breast darker, more dull gray, less brownish; shanks darker, more dusky olive, less tawny olive.

RANGE.—Known only from the type locality, and nearby Las Delicias, in the Subtropical Zone of the Páramo Tamá region, near the Colombian frontier.

DESCRIPTION OF TYPE.—Crown a little lighter than Olivaceous Black with narrow black tips; nape a little lighter, more grayish than crown, and with no black tipping; upper back like nape but with a pale brownish wash, becoming brighter on lower edge; sides of forehead and superciliary streak broadly whitish; lores blackish with whitish bases; a narrow white eye-ring; subocular area black with whitish streaks; auriculars whitish with blackish edgings on lower half, with broad blackish tipping on upper half; post-ocular streaks blackish; malar streak white with a buffy wash; back and rump Amber Brown X Hazel; upper tail-coverts olivaceous Brussels Brown; chin and throat whitish with wide black streaks at sides; sides of neck dark gray; chest at midline pale brownish-white, at sides dark gray; breast dull grayish with a Pinkish Buff wash; flanks and sides of breast dull grayish with a brownish-buff wash, becoming more brownish inwardly; crissum a little brighter than breast, more pale Warm Buff; under tail-coverts near Buckthorn Brown with scattered small black shaft spots; shanks dull olive-brown. Remiges brownish black; primaries with narrow Buckthorn Brown outer edgings, slightly lighter, more grayish, on first three and on outer halves of remainder; secondaries with broader, richer, edgings, more dark Ochraceous-Tawny; tertiaries with outer vanes like outer edgings of secondaries, the inner vanes with a dusky olive-tawny wash; wing-coverts like back; bastard wing and primary coverts dark brown with narrow cinnamon-brown outer edges; under wing-coverts light buffy-brown; axillaries light olivaceous-buffy; inner edges of remiges dull grayish buffy-white. Tail with broad black bars interspersed with equally broad olive-buff bars. Bill: upper mandible (in life), "black," lower mandible, "gray"; legs "light brown"; iris "brown." Wing, 64.5 mm.; tail, 67.5; exposed culmen, 18.5; culmen from base, 21; tarsus, 25.

REMARKS.—Females differ slightly from males by having crowns lighter, more dusky olivaceous, less blackish. Also, they appear to have shorter wings, tail and tarsi, as follows. Range of measurement of four males: wing, 64.5–67 mm.; tail, 67.5–69; exposed culmen (two skins), 18–18.5; cul-

men from base (two skins), 21; tarsus, 25–26. Range of measurement of two females: wing, 60.5–63; tail, 58.5–62.5; exposed culmen, 17.5–18; culmen from base, 19–21; tarsus, 22.5–24.

We know of no specimens of races of *mystacalis* from authentic localities in the Bogotá region. Apparently in all the eastern Andes of Colombia only *amaurogaster*, from Buena Vista, is known. One native "Bogotá" skin of *amaurogaster* probably also came from Buena Vista.

The only known specimen of *T. macrurus* Allen¹ is a native "Bogotá" skin. It is quite different from all of the races of *mystacalis*. Chapman² considers it a distinct species but Hellmayr,³ although he lists it with specific rank, is "inclined to believe" it may prove to be a "freak" of *T. m. amaurogaster*.

SPECIMENS EXAMINED

T. m. mystacalis.—ECUADOR: Paramba, N. Ecuador, 1 ♂; Esmeraldas, 1 ♀; Alamor, Prov. de Loja, 1 ♂, 1 ♀ (?); Bucay, Prov. de Chimborazo, 2 ♂; Chimbo, 2 ♂; Zaruma, Prov. del Oro, 1 ♂, 1 ♀; Punta Santa Ana, Prov. del Oro, 1 ♀; Naranjo, Prov. de Guayas, 1 ♂. COLOMBIA: La Candela, Huila, 1 ♀; San Augustin, Huila, 1 ♀; Andalucia, Huila, 1 (?).

T. m. saltuensis.—COLOMBIA: Palmira, Cauca, 3 ♂; San Antonio, Cauca, 1 ♂, 3 ♀; Salento, Cauca, 1 ♀; Popayan, Cauca, 1 ♀; Mari Lopez, Cauca, 1 ♀.

T. m. amaurogaster.—COLOMBIA: Buena Vista, E. Andes, 3 ♂ (inc. type), 2 ♀; "Bogotá," 1 (?).

T. m. tachirensis.—VENEZUELA (Phelps Collection): Villa Paez, Páramo Tamá region (2060–2300 m.), 2 ♂ (inc. type), 1 [♂], 1 ♀; Las Delicias, Páramo Tamá region (1650–2340 m.), 1 ♂, 1 ♀.

T. m. consobrinus.—VENEZUELA (Mérida region): Hechicera, 1 ♂; El Valle, 1 ♂, 3 ♀, 3 (?); Nevados, 1 ♂; Los Duraznos, 2 ♂, 1 ♀.

T. m. ruficaudatus.—VENEZUELA: Cumbre de Valencia, 2 ♂, 1 ♀; Galipán, 1 ♂.

T. macrurus.—COLOMBIA: "Bogotá," 1 (? (type)).

Dendroica petechia paraguanae, new subspecies

TYPE from La Boca, Adicora, Paraguaná Peninsula. No. 13289, Phelps Collection, Caracas. Adult male collected May 1, 1941, by Ventura Barnés, Jr. Altitude, sea level. (Type

¹ 1889, Bull. Amer. Mus. Nat. Hist., II, p. 137.

² 1914, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 180.

³ 1934, Field Mus. Nat. Hist., Zool. Ser., XIII, Pt. 7, p. 197.

on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *D. p. erithachorides* but crown darker reddish-brown, more Auburn, less light Chestnut; lores, eye-ring and auriculars not solid reddish-brown like crown but yellow with subobsolete chestnut tipping; throat not uniform reddish-brown, lighter than crown, but with yellow striping; back less yellowish, more olivaceous, with distinct dusky feather centers not present on the type of *erithachorides*.

RANGE.—Known only from La Boca, Adicora, on the eastern shore of the Paraguaná Peninsula.

DESCRIPTION OF TYPE.—Crown dark reddish-Auburn, with faintly yellowish tipping at base of upper mandible; hind neck narrowly Sulphine Yellow; back Pyrite Yellow with strong dusky feather centers giving the back a dull striped appearance, becoming brighter, more Wax Yellow, on lower rump and upper tail-coverts. Lores, eye-ring and auriculars Primuline Yellow with faint chestnut tipping; chin, at base of lower mandible, yellow; malar region near Auburn, becoming lighter more antique brown on throat, where it is noticeably striped with Primuline Yellow; chest, abdomen, under tail-coverts, flanks, and shanks, Primuline Yellow with Antique Brown striping, like that of throat, continuing solidly along midline to central chest where the striping thins out considerably and becomes obsolete on abdomen and under tail-coverts; sides of chest and flanks moderately striped, the stripes becoming fewer and narrower toward region of tail. Remiges brownish fuscous; primaries narrowly edged with olive yellow, brighter and narrower on outermost; secondaries and tertiaries, excepting innermost, with edges a little more pallid and a little broader; innermost tertial with external vane solid light olivaceous-yellow. Lesser upper wing-coverts like middle back; middle series dusky olive with broad Strontian Yellow tipping; greater series dusky olive with external edges like median series; primary coverts like others but with narrow dull Yellowish Citrine edging; under wing-coverts and axillaries near Amber Yellow, brighter on shoulder; inner margins of remiges pale Amber Yellow. Tail near Sepia with dusky central streaks on central rectrices, with subobsolete external margins, Olive-Ocher; inner vanes (except on central pair where it is obsolete, and on tips) largely Amber Yellow. Bill (in life), "black"; legs, "brown"; iris, "brown." Wing, 64 mm.; tail, 51.5; exposed culmen, 11.5; culmen from base, 15; tarsus, 21.

REMARKS.—Comparing the specimens of *erithachorides* from the eastern coast of the Goagira Peninsula with the type of that race, the former have a darker hood, and have striping on the back similar to *paraguanæ*. The new form is similar to the type of *erithachorides* in size.

SPECIMENS EXAMINED

- D. p. eoa*.—JAMAICA: 11 ♂, 10 ♀, 1 (?).
 GRAN CAYMAN I.: 3 ♂, 3 ♀.
D. p. gundlachi.—CUBA: 2 ♂, 1 (?).
D. p. albicollis.—STO. DOMINGO: Monte Cristi, 2 ♂; Sto. Domingo, 1 ♂.
D. p. solaris.—HAITI: Gonave, 1 ♂, 1 ♀.
D. p. flaviceps.—BAHAMAS: Andros I., 6 ♂ (inc. type), 2 ♀.
D. p. cruciana.—PUERTO RICO: 10 ♂, 6 ♀, 5 (?).
D. p. barthelemyi.—ANTIGUA: 7 ♀. SAN MARTIN: 1 ♀. ST. THOMAS: 1 ♂, 1 ♀.
D. p. melanoptera.—GUADALUPE: 3 ♂, 7 ♀. DOMINICA: 8 ♂, 4 ♀, 3 (?).
D. p. ruficapilla.—MARTINIQUE: 4 ♂, 1 ♀.
D. p. babad.—ST. LUCIA: Port Castries, 1 ♂.
D. p. alsiosa.—GRENADINES: 5 ♂, 3 ♀.
D. p. petechia.—BARBADOES: 6 ♂, 4 ♀, 1 (?).
D. p. rufopileata.—CURAÇAO: 12 ♂, 6 ♀.
 ARUBA: 1 ♂, 2 ♀. BONAIRE: 1 ♂. VENEZUELA: Testigos I., 4 ♂, 5 ♀; Blanquilla I., 3 ♂, 4 ♀; Los Roques I., 2 ♂.
D. p. ruftvertex.—MEXICO: Cozumel I., 7 ♂, 2 ♀.
D. p. bryanti.—MEXICO: Quintana Roo, 6 ♂, 2 ♀; Mazatlan, 1 ♀; Progreso, 1 ♂; Tampico, 3 ♂, 1 ♀. BRITISH HONDURAS: Belize, 1 ♂. NICARAGUA: Corinto, 7 ♂, 2 ♀, 1 (?). COSTA RICA: Punta Piedra, 7 ♂, 1 ♀; Figres, 3 ♂, 1 ♀; El Zapatal, 3 ♂, 3 ♀; Punta Mala, 1 ♀.
D. p. castaneiceps.—LOWER CALIFORNIA: La Paz, 8 ♂, 5 ♀.
D. p. xanthotera.—GUATEMALA: Ocos, 3 ♂, 2 ♀.
D. p. erithachorides.—COLOMBIA (U. S. Nat. Mus.): Cartagena, 1 ♂ (type). VENEZUELA (Phelps Collection): Paraguaná, Goagira Peninsula, 3 ♂, 2 ♀; Castilletes, Goagira Peninsula, 1 ♂, 1 ♀.
D. p. paraguanæ.—VENEZUELA: Paraguaná Peninsula, 1 ♂, 1 ♀; La Boca, Adicora, Paraguaná Pen., 2 ♂, 4 ♀. VENEZUELA (Phelps Collection): La Boca, Adicora, Paraguaná Pen., 23 ♂, 19 ♀, 3 (?).
D. p. aequatorialis.—PANAMA: Pearl I., 6 ♂, 5 ♀, 1 (?); Corozal, 1 ♂, 1 ♀, 1 (?); Balboa, 2 ♂; Panamá, 2 ♂, 1 ♀.
D. p. peruviana.—COLOMBIA: Tumaco, Nariño, 3 ♂, 4 ♀. ECUADOR: 6 ♂, 2 ♀; coast of Manavi, 1 ♂, 1 ♀; Isla de Puna, 1 ♀, 1 (?); Esmeraldas, 2 ♂; Guayaquil, 1 ♂.
D. p. aureola.—ECUADOR: Indefatigable I., Galapagos Islands, 2 ♂.

Basileuterus zimmeri, new species

TYPE from Queniquea, Táchira. No. 9296, Phelps Collection, Caracas. Adult male collected November 10, 1940, by Ventura Barnés, Jr. Altitude, 1900 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Of the species listed as examined (see below), *zimmeri* is nearest to *B. luteoviridis*. However, this new species differs from all by having feet, legs, and talons (in dried skins)

dark slate-color instead of light brownish (various tints). The tail differs from all these species as it is blackish brown above with narrow Olive-Citrine outer edgings instead of Olive-Citrine with somewhat lighter outer edgings, and below glossy Mouse Gray instead of dark Yellowish Citrine. It also differs from all in having outer primary solid black (both vanes) instead of with light outer vanes (various shades of olive-buff) and dark inner vanes. It differs from *B. l. luteoviridis* by having superciliaries much lighter, Strontian Yellow instead of dull Wax Yellow, and more expansive, extending from base of upper mandible to supra-auriculars instead of becoming subobsolete over eyes; post-ocular space darker, less brownish, more olive-black; upperparts richer green, more yellowish olive-green, less dull Olive-Citrine; sides of chest and flanks darker olive, less yellowish citrine.

RANGE.—Known only from the upper Subtropical Zone in the States of Táchira and Trujillo, at the localities listed.

DESCRIPTION OF TYPE.—Head near Olive-Green with an inconspicuous wash of Warbler Green, strongest on forehead, obsolete on hind crown where it is replaced by faint dusky edging; forehead at base of upper mandible near Strontian Yellow, tinted narrowly at midline with color of the forecrown; superciliaries Strontian Yellow continuing posteriorly to supra-auriculars, becoming slightly less brilliant, more oliveaceous, over auriculars; lores and post-ocular space dusky; auriculars like central pileum; back and rump Olive-Green \times Warbler Green; upper tail-coverts a hue lighter than back; concealed portions of throat grayish at feather bases with a narrow whitish subterminal band, strongly tipped on exposed surfaces with Strontian Yellow, with a few of the whitish areas showing through; chin mostly dull white with a few subobsolete yellow tippings; malar region rich Strontian Yellow with subobsolete oliveaceous tippings on upper edge; chest at midline darker yellowish than throat with a faint oliveaceous-orange wash, sides and inner edges of flanks darker, near yellowish Serpentine Green; breast, abdomen, sides of these parts and under tail-coverts Strontian Yellow with a wash of Lemon Chrome on central abdomen, becoming less brilliant more Amber Yellow on crissum and under tail-coverts; shanks dark gray on concealed portions of feathers with broad yellowish-olive subterminal bands and narrow yellowish tipping. Remiges dark brownish-black; primaries with outer edgings light oliveaceous-yellow (becoming obsolete on outer halves) except on first primary which is entirely black; secondaries with broader, darker edgings, more Citrine; tertiaries with outer vanes almost completely Dark Citrine; lesser upper wing-coverts like back; median coverts blackish gray with edgings approaching Olive-Citrine; greater coverts lighter olive with a Pyrite Yellow cast; bastard wing and primary coverts blackish with narrow dark olive edges. Under wing-coverts dull glossy-white with traces of yellow, becoming strongly

yellow, with signs of fine oliveaceous tipping, on wrist; axillaries near Pinard Yellow; inner edges of remiges glossy grayish-white. Tail dark brownish-black with outer edgings oliveaceous Yellow Citrine; central pair of rectrices with lighter, more dusky, oliveaceous inner vanes, except for a slender brownish-black shaft stripe; tail below near Light Mouse Gray with lighter oliveaceous-gray outer edgings following the pattern as described for the top. Bill (in life), "black"; legs, "dusky"; iris, "light brown." Wing, 69.5 mm.; tail, 61; exposed culmen, 11; culmen from base, 14; tarsus, 20.

REMARKS.—It gives us a great deal of pleasure to name this new bird for our friend and councillor, Mr. John Todd Zimmer, Executive Curator of Birds of The American Museum of Natural History.

Two males, and one skin which is presumably also a male, show the following range of measurement: wing, 69.5–75.5 mm.; tail, 61–61.5; culmen from base, 13.5–14; tarsus, 20–21. The only female collected has smaller wings, tail and tarsus, as follows: wing, 66.5 mm.; tail, 57.5; culmen from base, 14; tarsus, 19. In coloration it is similar to the males.

It is noteworthy that the Mérida region, which has been so intensively collected, lies between the two mountains where *zimmeri* is found.

SPECIMENS EXAMINED

B. zimmeri.—VENEZUELA (Phelps Collection): Queniquea, Táchira (1900 meters), 2 ♂ (inc. type): Páramo Zumbador, Táchira (higher up on the same mountain as the previous locality. 2300 meters), 1 ♀; Páramo Misísi (2100 meters), 1 ♂ (?).

B. l. luteoviridis.—ECUADOR: Tambillo, Río Upano, 1 (?); Zuna, Río Upano, 2 (?); Sumaco Arriba, 1 ♂. COLOMBIA: "Bogotá," 6; Coachi, Bogotá, 2 (?); Tomeque, Bogotá, 1 (?); Almaguer, Cauca, 2 ♂; Subia, Cundinamarca, 1 ♂; "Colombia," 1 (?).

B. richardsoni.—COLOMBIA: Popayan, Cauca, 1 ♂, 3 ♀, 1 (?); Laguneta, Cauca, 1 ♂.

B. s. signatus.—PERT: Marcapata, 1 ♀; Cumpang, 1 (?); Urubamba Cañon, 1 ♂, 1 ♀.

B. flaveolus.—BRAZIL: 50. PARAGUAY: Fort Wheeler, 1 ♀. BOLIVIA: Prov. Sara, 1 ♂. VENEZUELA: Las Quiguas, 1 ♂; Mt. Bucarito, Lara, 1 (?); El Limón, Puerto La Cruz, 2 ♂; Galipán, Cerro El Ávila, 1 ♀.

B. griseiceps.—VENEZUELA: Andes of Cumaná, 2 (?).

Poecilothraupis lacrymosa tamae, new subspecies

TYPE from Páramo Tamá. No. 11248, Phelps Collection, Caracas. Adult male collected Feb-

ruary 20, 1941, by Ventura Barnés, Jr. Altitude, 3000 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Similar to *P. l. olivaceiceps* but under tail-coverts lighter, more Wax Yellow, less Primuline Yellow; chin with lighter more Amber Yellow tipping, less Primuline Yellow; forehead, superciliary streak, auriculars and posterior malar region averaging brighter green, more light Olive Green, less dull Dark Citrine; crown and back averaging lighter, grayish blue, less dusky brownish-blue; throat, chest and abdomen lighter, more dark Primuline Yellow, less dark Yellow Ocher. Size similar.

RANGE.—Known only from the Temperate Zone of the Páramo Tamá, State of Táchira, near the Colombian frontier.

DESCRIPTION OF TYPE.—Head dull grayish-blue; forehead, superciliary streak (which extends posteriorly to post-auricular edge), post-ocular area and auriculars near light Olive Green, a little more yellowish on outer halves of auriculars; lores a little more dusky olive; anterior half of malar region like lores, posterior half like auriculars with a few prominent dull Primuline tippings; a bright Wax Yellow suborbital spot; a bright irregular area of Primuline Yellow running back from posterior terminal of superciliaries and auricular feathers (this area is largely concealed in this specimen due to the make of the skin); back like crown becoming brighter on rump and upper tail-coverts, where it is strongly washed with Deep Soft Blue-Violet; chin Wax Yellow, with a few dusky tippings; throat and chest bright Primuline Yellow with a wash of Yellow Ocher on lower throat and more strongly on chest; sides of chest dusky olive; abdomen and under tail-coverts Primuline Yellow, lightest at midline; flanks and sides of abdomen darker than central abdomen, the inner edges of flanks and sides of abdomen with olivaceous shaft streaks; shanks dusky gray on concealed portions of feathers, with broad olive tips. Remiges a little darker than Deep Mouse Gray, becoming blacker on secondaries and tertiaries; primaries with narrow outer edgings Pale King's Blue, becoming obsolete on outer halves, outermost primary solid Deep Mouse Gray; secondaries with narrow outer edgings Neropaline Blue; tertiaries with broad edgings of dull Neropaline Blue; lesser upper wing-coverts, on exposed surfaces, near glossy Deep Soft Blue-Violet; median series dusky black with broad tipping like that of lesser series; greater coverts dusky black with narrow outer edgings similar to the blue of the other coverts; bastard wing dusky black with a faint bluish outer edging; primary coverts with outer edgings darker and more bluish, less violet; under wing-coverts dark gray with whitish sides and broad whitish tips, sometimes with subobsolete yellowish tipping which appears stronger on innermost coverts, at wrist the white being largely replaced with dark gray feathers which bear light yellowish or buffy-yellow tips; axillaries light gray on basal halves and Citron Yellow on outer halves; remiges below glossy

dusky-gray, slightly lighter on inner edges. Tail above dusky black, with narrow Neropaline Blue outer edgings, outermost rectrices completely dusky black without bluish outer edgings. Bill (in life), "black"; legs, "black"; iris, "brown." Wing, 90.5 mm.; tail, 76.5; exposed culmen, 12.5; culmen from base, 16; tarsus, 25.

SPECIMENS EXAMINED

P. l. melanogenys.—COLOMBIA: Santa Marta, 6 ♂, 3 ♀.

P. l. melanops.—VENEZUELA (Mérida region): La Culata, 7 ♂, 1 (?); El Valle, 2 ♂, 1 ♀; El Escorial, 2 ♂, 1 ♀; El Loro, 1 ♂; Nevados, 1 ♂; "Mérida," 1 ♀, 6 (?).

P. l. lamae.—VENEZUELA (Phelps Collection): Páramo Tamá, State of Táchira (3000 meters), 5 ♂ (inc. type), 3 ♀.

P. l. olivaceiceps.—COLOMBIA: Paramillo, Antioquia, 4 ♂, 2 ♀; Medellín, 2 (?); Santa Elena, Medellín, 1 (?); Sabana Larga, 1 (?); "Bogotá," 1 (?).

P. l. palpabrosa.—ECUADOR: 38. COLOMBIA: Popayan, Cauca, 7 ♂, 9 ♀; Almaguer, Cauca, 2 ♂, 2 ♀; Laguneta, Cauca, 7 ♂, 4 ♀.

P. l. subsp. (?).—ECUADOR: Taraguacocha, 3 ♂, 3 ♀.

P. l. lacrymosa.—PERU: Maraynioc, Junín, 1 ♂, 1 ♀.

Chlorospingus ophthalmicus falconensis, new subspecies

TYPE from the San Luis Mountains, above San Luis, in the State of Falcón. No. 5890, Phelps Collection, Caracas. Adult male collected March 27, 1940, by Ventura Barnés, Jr. Altitude, 1200 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *C. o. fulvularis* from Bolivia, but with crown much darker, more brownish black, less dusky olivaceous-brown; throat and malar regions with the blackish tippings broader and much more numerous.

RANGE.—Known only from the lower Subtropical Zone on the San Luis Mountains, above San Luis, in the State of Falcón.

DESCRIPTION OF TYPE.—Crown and hind neck dark brownish-black; sides of forehead dull brownish-white with fine blackish tips; lores, and line under eye, like crown; top and base of ocular space ringed narrowly with white, with a little white area extending over the post-loral area; anterior auriculars dusky brown becoming lighter, more dull Cinnamon-Buff posteriorly; back and shoulders Citrine with brighter Citrine edgings, becoming lighter on rump where it is faintly washed with Pyrite Yellow; upper tail-coverts like back. Chin, throat and malar region Cinnamon-Buff, richer on malar region, more light clay-color, tipped vividly with black especially on central throat; chest with a richly colored crescentic patch of Yellow Ocher; anterior sides of breast, sides of chest, flanks, shanks and under tail-coverts Pyrite Yellow, washed with olive on sides of chest, becoming

lighter more yellowish on under tail-coverts: lower breast and abdomen dull grayish-white. Remiges, dark brownish-black; primaries with outer edgings narrowly olivaceous Pyrite Yellow becoming grayish on outer halves, the first primary with a conspicuous dull buffy-white outer edging; secondaries with slightly broader darker, edgings; tertiaries with edgings similar to those of the secondaries but very broad extending over entire outer vane; lesser, median and outer vanes of greater wing-coverts. Pyrite Yellow X Warbler Green; bastard wing dusky black with a narrow buffy outer edging; primary coverts brownish black with olive outer edgings; under wing-coverts glossy white with subobsolete tipping; wrist Pale Lemon Yellow; axillaries bright Barium Yellow; inner edges of primaries dull white. Tail dusky brown with olive Pyrite Yellow outer vanes, central pair with dusky-olive inner vanes. Bill (in life), "black"; legs, "black"; iris, "grayish." Wing, 70.5 mm.; tail, 59; exposed culmen, 11.5; culmen from base, 14.5; tarsus, 22.

REMARKS.—It is noteworthy that the nearby races, *jacqueti* and *venezuelanus*, both of which occur in the adjoining State of Lara, are quite different from *falconensis*, while the most similar race occurs only in far away Bolivia.

SPECIMENS EXAMINED

C. o. ophthalmicus.—MEXICO: Jalapa, Vera Cruz, 5 ♂, 2 ♀; "Mexico," 1 (?).

C. o. dringhi.—GUATEMALA: Finca Sepur, 9 ♂, 6 ♀, 2 (?); Barrilos, 1 ♀; Nabaj, 1 ♂; "Guatemala," 1 (?).

C. o. postocularis.—GUATEMALA: Antigua, 1 ♀; San Lucas, 1 ♂; San Mateo, 1 ♂, 1 ♀.

C. o. honduratus.—NICARAGUA: San Rafael del Norte, 2 ♂, 1 ♀.

C. o. regionalis.—NICARAGUA: 16. COSTA RICA: 22.

C. o. novicius.—COSTA RICA: Las Vueltas, Copey, 1 ♂; Sta. Maria de Dota, 2 ♂, 2 ♀; Volcan Irazú, 2 ♂, 2 ♀. PANAMA: Boqueta, Chiriquí, 2 ♂, 1 ♀, 2 (?).

C. o. falconensis.—VENEZUELA (Phelps Collection): San Luis Mts., above San Luis (1200–1360 m.), 2 ♂ (inc. type), 3 ♀; Curimagua, San Luis Mts., (1300 m.), 2 ♀, 1 ♂.

C. o. jacqueti.—VENEZUELA: Galipán, Cerro El Avila, 3 ♂, 4 ♀; Silla de Caracas, 1 ♂, 1 ♀; Colonia Tovar, 3 ♂, 2 ♀; El Limón, Pto. de la Cruz, 1 ♂, 1 ♀; Cumbre de Valencia, 3 ♂, 2 ♀; Mt. Bucarito, Tocuyo, 2 (?); Caripe, Monagas, 4 (?). VENEZUELA (Phelps Collection): Las Culebrillas, Cerro El Avila, 1 ♂; Junquito, 4 ♂, 1 ♀; Colonia Tovar, 1 ♂, 1 ♀; Páramo Misisí, 7 ♂, 7 ♀, 3 (?); Timotes 1 ♂.

C. o. venezuelanus.—VENEZUELA (Mérida region): Escorial, 2 ♂; El Valle, 2 ♂, 1 ♀; Montañas Sierra, 1 ♂; El Loro, 1 (?); Culata, 1 ♂; "Mérida," 5 (?). VENEZUELA (Phelps Collection): Cubiro, 2 ♂, 3 ♀; Seboruco, 2 ♂;

Páramo Zumbador, 2 ♂, 4 ♀, 1 (?); Altamira Barinas, 1 ♀; Las Delicias, 1 ♂, 1 ♀.

C. o. nigriceps.—COLOMBIA: La Candela, Huila, 1 ♂; El Eden, E. Quindío Andes, 1 ♂; Río Toche, Tolima, 1 ♂; Sta. Elena, Antioquia, 3 ♂, 3 ♀, 1 (?); Palmira, Cauca, 1 ♀ (type).

C. o. bolivianus.—BOLIVIA: Tujma, Cochabamba, 2 ♂; Nequejanura, 1 ♂, 1 ♀.

C. o. fulvularis.—BOLIVIA: Incachaca, 19 ♂, 8 ♀, 1 (?); Yungas, 7 ♂, 11 ♀, 1 (?); Lacotal, 3 ♂, 2 ♀; Roquefaldia, 2 ♂, 1 ♀.

C. o. argentinus.—ARGENTINA: Ledesma, Jujuy, 1 ♂, 2 ♀, 1 (?); Metan, Salta, 1 (?).

Catamenia inornata mucuchiesi, new subspecies

TYPE from Páramo Mucuchies, State of Mérida. No. 14155, Phelps Collection, Caracas. Adult male (testes enlarged to diameter of 6 mm.) collected September 14, 1941, by F. Benedetti. Altitude, 3800 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *C. i. minor* of the Páramo Zone of the central and eastern Andes of Colombia and the Andes of Ecuador and part of Peru, but backs decidedly darker, more dark bluish-slate, less dull greenish-gray; back striping darker, more blackish, less dark brownish; throat and chest averaging deeper gray; underparts with a decidedly paler buffy wash, especially on throat and chest. Size similar.

RANGE.—Known only from Páramo Mucuchies and Páramo San Antonio, in the Andes of Mérida, at altitudes between 3700 and 3900 meters.

DESCRIPTION OF TYPE.—Crown dull bluish Neutral Gray with narrow dusky streaks on feather centers; back like crown but with conspicuous dusky-black central feather streaks; rump and upper tail-coverts a little more bluish than Neutral Gray; lores with dull grayish tips; auriculars dark grayish with a faint brownish wash; chin, throat, chest, upper breast and sides of chest, dull gray with a subobsolete buffy wash; lower breast, abdomen, flanks and sides of abdomen, slightly lighter gray than throat, and with the buffy wash becoming stronger toward crissum which is predominately Cream-Buff; under tail-coverts Mikado Brown with a few subobsolete buffy tips. Remiges dusky black; primaries and secondaries with narrow whitish outer edgings becoming subobsolete or obsolete on outer halves, except outermost primary which shows only faint traces of the whitish outer edging; tertiaries with broader whitish outer edgings; upper wing-coverts blackish with dark bluish-gray edgings; bastard wing dusky black with faint brownish-gray outer edging and tip; primary coverts with narrow outer edgings like coverts; under wing-coverts and axillaries like sides of chest; inner edges of remiges glossy dull grayish-white. Tail blackish with whitish outer edgings, except outer rectrices which are narrowly edged with brownish gray, central pair with whitish edgings on both vanes. Bill (in life) "flesh";

legs, "brownish flesh"; iris, "brown." Wing, 69.5 mm.; tail, 60.5; exposed culmen, 9.5; culmen from base, 12.5; tarsus, 21.

REMARKS.—Thirteen adult males show the following range of measurements: wing, 64–71 mm.; tail, 52.5–62.5; exposed culmen, 9.5–10; culmen from base, 10.5–12.5; tarsus, 19.5–21. Adult females appear to have smaller wings and tails than the males. Two of them range as follows: wing, 65–66.5 mm.; tail, 56.5–58.5; exposed culmen, 9.5; culmen from base, 12; tarsus 20.5.

Measurements of five juvenals of *C. i. minor* and of eight juvenals of *C. i. mucuchiesi* indicate that in this stage the new race has larger wing, tail and culmen from base: *C. i. minor*: wing, 62–65 mm.; tail, 55–55.5; culmen from base, 10–11; tarsus, 21.5–22. *C. i. mucuchiesi*: wing, 65–69 mm.; tail, 56–62.5; culmen from base, 11.5–12; tarsus, 20.5–21.

Study of the series of eighty specimens of the species *inornata* in The American Museum of Natural History, and in the Phelps Collection, presented quite a problem because there seemed to be so much individual variation. Critical study of the various plumages has revealed, however, that actually there is comparatively little variation in birds of similar age and sex. Thus, following the example set by Dwight¹ in his paper on the genus *Junco*, we have segregated the specimens into five distinct plumages, adult male and female, young male and female (first-winter plumage), and juvenals. These plumages of *mucuchiesi* are described as follows:

ADULT MALES.—Crown, back and rump, dark bluish slate with conspicuous black streaks; throat, breast and abdomen light slate-gray, with a buffy wash, subobsolete on throat and chest, stronger toward crissum where it becomes Cream-Buff; under tail-coverts near Mikado Brown. Upper mandible dull Apricot Orange.

YOUNG MALES.—Like adults but with an olivaceous wash on crown, back and rump; with prominent whitish tipping on middle back instead of subobsolete tipping; lower parts much brighter buff, especially throat and chest; under tail-coverts, and upper mandible, like that of the adult male.

ADULT FEMALES.—Differing from adult male by having all of upperparts washed strongly

with brownish olive with no suggestion of bluish slate; striping on back dark brownish instead of black; underparts buffy gray, slightly lighter than that of the young males; under tail-coverts Mikado Brown like adult male but with broad buffy tips, instead of subobsolete buffy tips. Upper mandible Apricot Orange like that of adult males.

YOUNG FEMALES.—Like adult female but with light brownish upperparts, especially crown; throat and chest moderately striped with dusky brown; underparts a little lighter than that of the adult female; under tail-coverts near Mikado Brown, lighter than that of the adult female. Upper mandible Apricot Orange like that of adult female but with dusky sides and tip.

JUVENAL PLUMAGE, BOTH SEXES.—Differing from all others by having crown and nape pale buffy brown with conspicuous black shaft-streaks; back much brighter than any, near dull Tawny-Olive, with wide black streaks; rump buffy brown instead of bluish slate or buffy slate; secondaries with broad brown outer edgings instead of narrow whitish edgings; throat and chest whitish gray, lighter than any other, contrasted profusely with dusky brown stripes which continue strongly, unlike any of others, over breast, flanks, sides of abdomen and under tail-coverts, and fade away on the lower abdomen; breast, abdomen, sides of abdomen and crissum, washed with light cinnamon-buff, strongest on lower abdomen; under tail-coverts, like sides of abdomen, with no traces of the Mikado Brown which is present in all other plumages. Upper mandible black with no traces of Apricot Orange which is present to some extent in each of the other stages.

Comparison of nine juvenals of *mucuchiesi* with six juvenals of *minor*, corroborates the validity of the new race. In fact, it is in this stage that these races appear most distinct as the following diagnosis indicates: ground color of throat and chest (of *mucuchiesi*) grayish white, not light brownish or buffy; remainder of underparts paler, more grayish Pinkish Buff, not Cinnamon-Buff; crown and nape decidedly paler, more buffy brown, less Cinnamon-Buff; back paler, more dull Tawny-Olive, less bright Snuff Brown.

SPECIMENS EXAMINED

C. i. inornata.—BOLIVIA: Pongo, 2 ♂. *C. i. minor*.—ECUADOR: Lloa, 1 ♂; Gualea, 2 ♂, 1 ♀; El Corazo, 1 ♀; El Paso, Río Charcay, Prov. de Asuay, 3 ♂; Mt. Chimborazo, 2 ♂, 4 ♀; Taraguacocha, Prov. del Oro, 1 ♀ (?), 1 (?); Mt. Pichincha, 3 ♀; Bestión, Prov. de Asuay, 1 ♂, 1 ♀; Cerro Guamani, 1 ♂; Cerro Huamoeni (sp. ?) Abajo, 1 ♂; Cañar, 1 ♂; Guachanama, Prov. de Loja, 1 ♀; Quito, 1 ♂, 3 (?). COLOMBIA: Santa Isabel, 4 ♂, 1 ♀, 2

¹ 1918, Bull. Amer. Mus. Nat. Hist., XXXVIII, Art. 9, p. 286.

(?); Valle de las Papas, Huila, 2 ♂, 2 ♀; La Peña, Bogotá, 1 (?); Neyon, Bogotá, 1 (?); Coachi, Bogotá, 2 (?); Bogotá, 1 (?); "Bogotá," 1 (?); Suba, 1 (?); Paramillo, Antioquia, 1 ♂; La Porquera, Cundinamarca, 1 ♀.

C. i. mucuchiesi.—VENEZUELA (Phelps Collection): Páramo Mucuchies, Mérida Andes (3700–3900 meters), 12 ad. ♂, 1 young, ♂, 2 young-juv. ♂, 1 juv. ♂, 3 ad. ♀, 1 young ♀, 5 juv. ♀, 3 juv. (?); Páramo San Antonio, Mérida Andes, 1 ad. ♂.

Atlapietes semirufus benedetti, new subspecies

TYPE from San Luis Mountains, above San Luis, State of Falcón. No. 5943, Phelps Collection, Caracas. Adult male collected April 2, 1940, by Fulvio Benedetti. Altitude, 1200 meters. (Type on deposit at The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *A. s. denisei* of the Subtropical Zone of north-central and north-eastern Venezuela, but hood decidedly lighter, more Raw Sienna washed lightly with Antique Brown, instead of light Sudan Brown with a faint Raw Sienna wash, especially on sides of hind crown; lores, eye-rings and auriculars much lighter, a little paler than Antique Brown, not Argus Brown; central throat much lighter, near Analine Yellow instead of a little darker than Raw Sienna; malar streak brownish yellow instead of light Antique Brown; chest and sides of breast decidedly lighter, more yellowish raw-sienna, less Antique Brown. Size similar.

RANGE.—Known from the Subtropical Zone in the States of Lara (Cubiro and Mt. Bucarito) and Falcón (the San Luis Mountains).

DESCRIPTION OF TYPE.—Hood Raw Sienna washed lightly with Antique Brown, becoming slightly lighter on sides of hind crown and on nape; lores, gape, subocular area and auriculars slightly darker than crown; back, rump and upper tail-coverts a little darker than Yellowish Olive; throat near Analine Yellow bordered on sides and on chin with brown similar to the crown; malar region with a narrow light-yellowish longitudinal stripe, approaching the throat in color but with subobsolete brownish tips giving a darker appearance; chest light yellowish raw-sienna, becoming a bit darker on sides of chest and anterior breast; central breast and abdomen Strontian Yellow; sides of lower breast and of abdomen yellowish Olive-Citrine with a few Sulphine Yellow edgings; under tail-coverts Dull Citrine with Sulphine Yellow edgings; shanks, on exterior portions, near Dark Citrine, on inner surfaces light Sulphine Yellow. Remiges dusky black; primaries with narrow Olive-Green outer edgings which change to dark gray on outer feather-halves, the outermost primary with entire outer edge dull grayish-white; secondaries with outer edgings a little darker; tertials with broad outer edgings of an amber olive-green cast; lesser and medium upper wing-coverts like back; greater series dusky black with broad

olive-green outer edgings which appear a little yellower than the back; bastard wing dusky black with a faint dusky-olive outer edge; primary coverts dusky black with subobsolete Olive-Green outer edgings; under wing-coverts glossy white with subobsolete yellowish tipping, near wrist becoming dusky gray with faint yellowish-olive tipping; wrist bright Pale Lemon Yellow; axillaries a little brighter than Pyrite Yellow; inner edges of remiges glossy grayish-white. Tail dusky black with broad Dark Citrine edges on outer vanes, outermost rectrices with edgings narrower and darker, more dusky olive, central pair with broad inconspicuous dusky-olive inner edges. Bill (in life): upper mandible, "brown," lower mandible, "gray"; legs, "brown"; iris, "red." Wing, 73.5 mm.; tail, 74; exposed culmen, 14; culmen from base, 17; tarsus, 14.5.

REMARKS.—Until today the known range of the species in Venezuela was limited to the coast mountains from Cumbre de Valencia to the interior of Cumaná. This new form extends the range of the species westward to the States of Lara and Falcón. Specimens in the Phelps Collection have extended the range of *A. s. majusculus* from Colombia into western Táchira, but there seems to be a gap in the Mérida region from where we have seen no records.

The sexes are alike in size and color.

SPECIMENS EXAMINED

A. s. semirufus.—COLOMBIA: Páramo de Coachi, Bogotá region, 6 (?); "Bogotá," 9; Quetame, E. Andes, 1 ♂.

A. s. majusculus.—COLOMBIA: Peña Blanca, Nantander, 1 ♀. COLOMBIA (Carnegie Museum): Peña Blanca, series, including type. VENEZUELA (Phelps Collection): Queniquea, Táchira, 7 ♂, 1 ♀, 1 (?); Delicias, Páramo Tamá region, Táchira, 5 ♂, 1 ♀; Villa Paez, Páramo Tamá region, 2 ♂.

A. s. benedetti.—VENEZUELA: Mt. Bucarito, Tocuyo, 1 (?). VENEZUELA (Phelps Collection): San Luis Mountains, above San Luis, Falcón (1200–1380 m.), 2 ♂ (inc. type), 3 ♀, 1 (?); Curimagua, San Luis Mountains, Falcón (1380 m.), 1 ♂, 2 ♀; Cubiro, Lara (1600–1900 m.), 1 ♂, 1 ♀, 1 (?).

A. s. denisei.—VENEZUELA: Cumbre de Valencia, 1 ♂, 1 ♀; Colonia Tovar, 1 ♂; Junquito, Caracas, 1 ♂; Galipán, Cerro El Ávila, 4 ♂, 4 ♀; Cotiza, Caracas, 2 ♂, 1 ♀; Los Dos Ríos, Sucre, 2 ♀; Campo Alegre Valley, Sucre, 1 ♂; Quebrada Seca, Sucre, 1 ♂; Los Palmales, Sucre, 1 ♀; Caripe, Monagas, 1 (?). VENEZUELA (Phelps Collection): Junquito, 2 ♀; Carupao, Miranda, 1 ♂; Las Culebrillas, Cerro El Ávila, 1 ♂.

***Myospiza aurifrons apurensis*, new subspecies**

TYPE from Santo Domingo, State of Táchira. No. 11967, Phelps Collection, Caracas. Adult male collected March 12, 1941 by Ventura Barnés, Jr. Altitude, 300 meters. (Type on deposit with The American Museum of Natural History.)

DIAGNOSIS.—Nearest to *M. a. cherriei* known only from the Tropical Zone at Villavicencio, southeastern Colombia, but with the dark areas of crown, back, wing-coverts, remiges and rectrices decidedly darker, more Fuscous-Black, less Hair Brown; also, the dark areas of crown and back (which consist of broad shaft-streaks) decidedly larger. Size similar.

RANGE.—Known only from the savannas of the upper Apure Valley in the States of Táchira, Apure and Barinas.

DESCRIPTION OF TYPE.—Crown heavily striped with blackish-brown shaft-streaks averaging half the width of the feathers, these streaks being fringed with pale Prout's Brown, strongest at sides of crown, with a few grayish edgings at central crown; sides of forehead, upper half of lores, superciliary stripe (which becomes obsolete over post-ocular area) and eye-ring (narrowly), bright Wax Yellow; auriculars dull smoke-gray, with faint brownish-gray tips; post-loral stripe brownish; superciliary stripe, above auriculars, dull smoke-gray; back dull brownish-gray with broad blackish-brown shaft-streaks on outer feather-halves, the dark areas, which are strongest across the central back becoming sub-obsolete on the rump and upper tail-coverts. Chin and throat grayish white; chest at midline like throat; sides of chest pale brownish-gray, becoming dark brownish-gray on inner edges; breast, abdomen, under tail-coverts, as well as throat, flanks and inner sides of abdomen, pale brownish-gray; shanks, on posterior surface. Hair Brown with faint whitish edgings, other surfaces being like breast. Remiges brownish black; primaries with narrow outer edgings light brownish-gray, becoming greenish gray on basal halves except on outermost; secondaries with outer edgings more brownish gray, becoming broader toward tertials; tertials with broad brownish-buff outer edgings and tips; exposed surface of lesser upper wing-coverts near Light Yellowish Olive with indistinct dusky centers; median and greater coverts dark brownish-black with pale brownish-white edgings; bastard wing with a narrow grayish outer edge; primary coverts with narrow pallid brownish edgings;

under wing-coverts white with subobsolete yellowish tipping, becoming broadly bright Wax Yellow on wrist; axillaries white washed with Wax Yellow; inner edges of remiges dull glossy grayish-white. Tail brownish black with Drab outer edgings, becoming lighter on outermost rectrices, central pair with narrow Drab inner edgings. Bill (in life), "horn"; legs, "flesh"; iris, "brown." Wing, 56.5 mm.; tail, 41.5; exposed culmen, 10.5; culmen from base, 13; tarsus, 21.

REMARKS.—This form has been named in honor of Señor Fulvio Benedetti, Collector for the Phelps Collection.

Males and females are similar in coloration. In measurement the males have wings and tail slightly longer. Range of measurement of four males: wing, 54–57 mm.; tail, 40–43; exposed culmen, 10.5–12; culmen from base, 13–14; tarsus, 20–21. Range of measurement of three females: wing, 52.5–54.5; tail, 38–40; exposed culmen, 10.5–12; culmen from base, 13–13.5; tarsus, 20.

M. a. cherriei is known only from one female (type) and one juvenile.

In regard to possible seasonal plumage changes, etc., it is to be noted that the type of *M. a. cherriei* was collected on March 12, and that our type, and six paratypes, of *M. a. apurensis*, were all obtained during that same month; in fact three specimens, including the type, were also collected on the 12th.

SPECIMENS EXAMINED

M. a. aurifrons.—BRAZIL: Porto Velho, R. Madeira, 2 ♂, 2 ♀; Faro, 2 ♂; Manaos, 3 ♂; Santarem, 1 ♀; Tefé, 1 ♀. BOLIVIA: Yungas, Cochabamba, 2 ♂, 1 ♀; Todos Santos, Cochabamba, 1 ♀. ECUADOR: Zamora, Loja, 7 ♂, 5 ♀; R. Suno Abajo, 1 ♂. COLOMBIA: Florencia, Caquetá, 3 ♂, 2 ♀; La Murelia, 1 ♂, 3 ♀, 1 (?).

M. a. cherriei.—COLOMBIA: Villavicencio, 1 ♀ (type), 1 (?) juv.

M. a. apurensis.—VENEZUELA (Phelps Collection): Santo Domingo, Rio Uribante, Táchira, 4 ♂ (inc. type), 3 ♀; Guasualito, 2 ♂; Palmarito, 1 (?); Barinas, 1 ♂.

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ONE NEW, AND OTHER LABROID FISHES FROM BALI¹

By J. T. NICHOLS

Reef fishes are probably more abundant in species in the East Indies than anywhere else. The Michael Lerner Australia-New Zealand Expedition of 1939 obtained a considerable collection of such fishes from the island of Bali for the American Museum, which previously have been sorted and tentatively identified by Mr. John Robas and the writer, but none critically studied until now.

The Labroid fishes, wrasses and parrots, are particularly numerous in this collection and presumably make up a considerable part of the reef fauna in the region. East Indian members of this group have recently been reviewed by de Beaufort (1940, Fishes of the Indo-Australian Archipelago, VIII). We follow his nomenclature, and have compared the number of species in our collection from Bali with those listed by him for the entire region.

We also include figures of a number of our species, of which good illustrations are not readily available. These have been kindly drawn for us by Katherine G. Van Cortlandt.

Thirty-four genera of wrasses and parrotfishes are recognized by de Beaufort from the Indo-Australian Archipelago—of which our Bali collection comprises 17 as follows.

CHOERODON BLEEKER

Figure 1

We have from Bali 1 of the 7 species listed by de Beaufort, *Choerodon anchorago* (Bloch).

BODIANUS BLOCH

Figure 2

We have 1 of the 5 species listed, *Bodianus birkunulatus* (Lacépède).

NOVACULICHTHYS BLEEKER

Figure 3

We have 2 of the 3 species listed, *Novaculichthys macrolepidotus* (Bloch) and *N. taeniurus* (Lacépède).

CHEILINUS LACÉPÈDE

Figures 4, 5

We have 4 of the 12 species listed, *Cheilinus bimaculatus* Cuvier and Valenciennes, *C. chlorurus* (Bloch), *C. diagramma* (Lacépède) and *C. trilobatus* Lacépède.

C. chlorurus is differentiated from other members of the genus listed, by having 10 versus 9 dorsal spines. But one of our 2 *C. bimaculatus* has 10 spines also, the other 9.

ANAMPSSES QUOY AND GAIMARD

We have one of the 9 species listed, *Anampses caeruleopunctatus* Rüppell.

CHEILIO LACÉPÈDE

We have the one species listed, *Cheilio inermis* (Forsk.).

THALASSOMA SWAINSON

Figures 6, 7, 8

We have 7 of the 11 species listed, *Thalassoma fuscum* (Lacépède), *T. güntheri* (Bleeker), *T. hardwicki* (Bennett), *T. janseni* (Bleeker), *T. lunare* (Linnaeus), *T. melanochir* (Bleeker), and *T. umbrostigma* (Rüppell); also an 8th species described here as new.

Thalassoma albolineum, new species

Figure 6

A *Thalassoma* with a patch of 5 or 6 scales at the top of the gill-cover; without transverse markings; in preserved material with a narrow white mesial lengthwise stripe from over the pectoral to the base of the caudal, bordered above and below by less well-defined blackish stripes; caudal margin concave, its corners exerted.

¹ Results of the Michael Lerner Ichthyological Expeditions, No. 29.

DESCRIPTION OF TYPE—No 14999 American Museum of Natural History, from Bali collected by the Michael Leiner Expedition of 1939.

Length to base of caudal, 115 mm. Depth in this length, 3.4, head, 3.2, eye in head, 5; snout, 2.6; interorbital, 3.7; width of body, 2.1; depth of peduncle, 2.4; pectoral, 1.3; ventral, 2.4, last dorsal spine, 4.1, longest dorsal ray, 3.5, anal ray, 3.6, caudal, 1.7

Dorsal rays, VIII, 13; anal, II, 12. Scales, 27.

Well compressed, deepest over pectoral, gradually tapering backward; profile gently convex, snout pointed, a pair of curved projecting canines in the middle of the upper and of the lower jaw, those of the upper jaw considerably the larger; maxillary reaching about halfway to vertical from front of eye; eye placed high, interorbital gently convex. Pectoral large, pointed, caudal small, concave behind with exerted corners. Scales on breast a little smaller than those on sides, lateral line slanting downward on the 20th to 22nd scales.

Color in preservative head and fore part of body back to base of pectorals, blackish, the lips and chin contrastingly paler—a narrow whitish mesial stripe from over the pectorals to the base of caudal, bordered above and below by broader, more obscure blackish stripes, which join a narrow black crescent, concave behind, across the base of the caudal, which is pale behind this. The points of the crescent are drawn out to make a very narrow dusky inner edge of the caudal margins. A faint pale shade runs backward on the upper side from about the middle of the body into the upper margin of the caudal, and similarly from the lower sides, which are pale behind the pectoral, into its lower margin, the margins being pale, very narrowly edged with dusky.

Pectorals and ventrals pale, the former slightly dusky toward the tip, dorsal more or less blackish between the first and third spines, otherwise pale, with a dusky margin; anal pale.

A paratype, 95 mm. long, is similarly colored; both show evidence of other intangible markings on their dark heads.

DUYMAERIA BLEEKER

We have the one species listed, *Duymaeria flagellifera* (Cuvier and Valenciennes).

LABROIDES BLEEKER

We have 1 of the 2 species listed, *Labroides dimidiatus* (Cuvier and Valenciennes).

STETHOJULIS GUNTHER

Figure 9

We have 6 of the 8 species listed, *Stethojulis albobittata* (Bonnaterre), *S. arillaris*

(Quoy and Gaimard), *S. kalosoma* (Bleeker), *S. phreakadopleura* (Bleeker), *S. strigiventer* (Bennett) and *S. trilineata* (Bloch and Schneider).

XENOJULIS DE BEAUFORT

We have the one species listed, *Xenajulis margaritaceus* (Macleay).

HALICHOERES RUPPELL

Figures 10, 11 and 12

We have 12 of the 37 species listed, *Halichoeres argus* (Bloch and Schneider), *H. binotopsis* (Bleeker), *H. centiquadrus* (Lacépède), *H. kawarin* (Bleeker), *H. leparensis* (Bleeker), *H. marginatus* (Ruppell), *H. nebulosus* (Cuvier and Valenciennes), *H. notopsis* (Cuvier and Valenciennes), *H. papilionaceus* (Cuvier and Valenciennes), *H. podostigma* (Bleeker), *H. scapularis* (Bennett) and *H. trimaculatus* (Quoy and Gaimard).

The striking pattern of scale marking figured for *Halichoeres argus* and *H. leparensis* (de Beaufort, 1940, p. 231) is also strongly suggested in *H. papilionaceus*, which furthermore has vertical fins marked little differently from *argus*. The three are probably closely related.

We have 9 specimens of *H. papilionaceus* from 70 to 90 mm. standard length, only 2 of *H. argus*, somewhat less well preserved, of 52 and 75 mm. Both have a differently colored caudal from what I find figured and described for *H. argus*, white with a black blotch terminally in the middle, sharply defined as in *H. papilionaceus* though of rather less extent. Their color is thus very like that of *H. papilionaceus*, except that the head markings are quite as figured for *H. argus*, well outside the considerable range of variation in *H. papilionaceus*, and the larger at least, in which that fin is perfect, has no black on the spinous dorsal, which definitely is not elevated in front as in *papilionaceus*. Of *H. argus* de Beaufort says: "Caudal yellowish, sometimes dusky or blackish towards its tip, covered by faint, dark edged, light ocelli," and Bleeker (1862, Atl. Ichth., I, Pl. xxxv, fig. 1) figures *H. guttatus* (equals *argus*) with a caudal with numerous ocelli, gradually

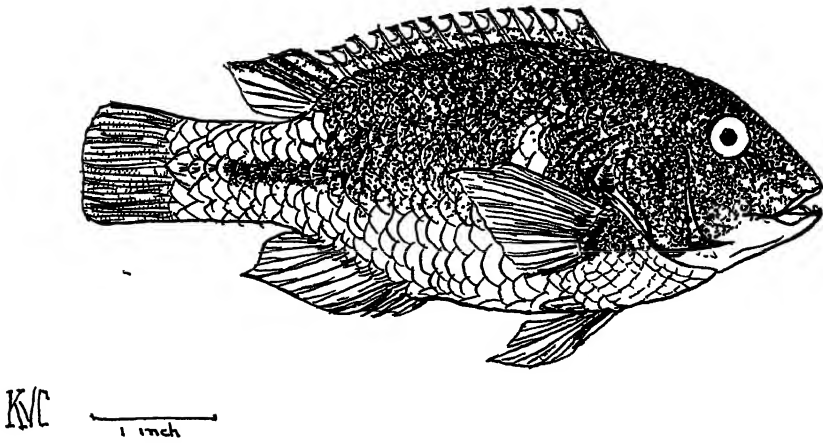


Fig 1. *Choerodon anchorago* (Bloch).

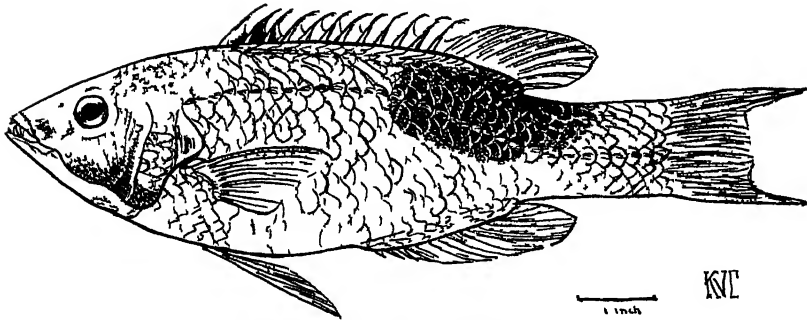


Fig 2. *Bodianus bilunulatus* (Lacépède).

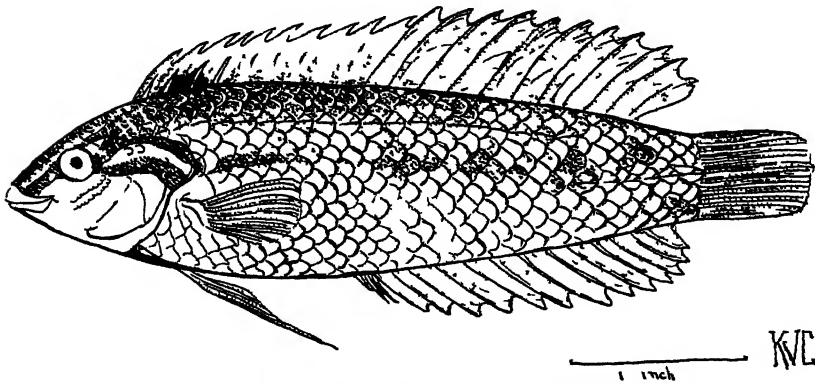


Fig. 3. *Novaculichthys macrolepidotus* (Bloch).

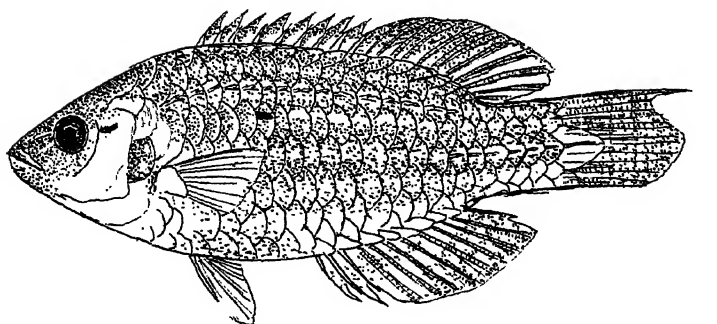


Fig. 4. *Cheilinus bimaculatus* Cuvier and Valenciennes.

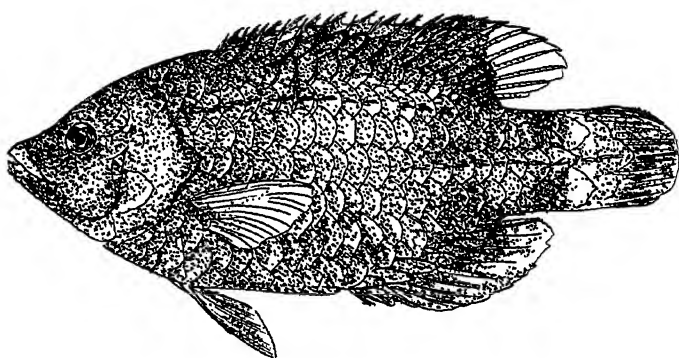


Fig. 5. *Cheilinus chlorurus* (Bloch).

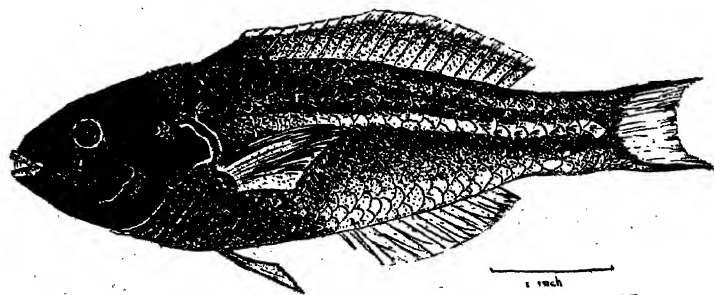


Fig. 6. *Thalassoma albolineum* Nichols, type.

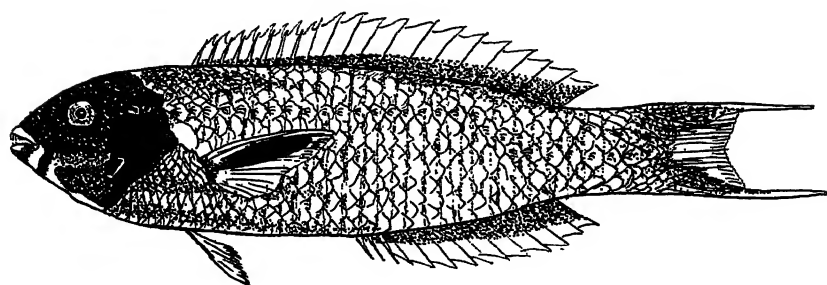


Fig. 7. *Thalassoma lunare* (Linnaeus).

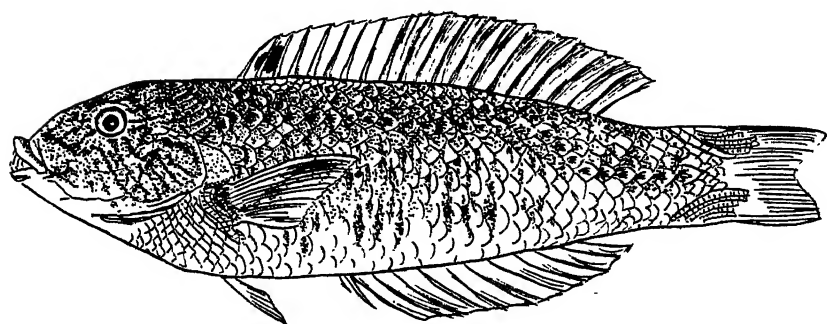


Fig. 8. *Thalassoma umbrostigma* (Rüppell).

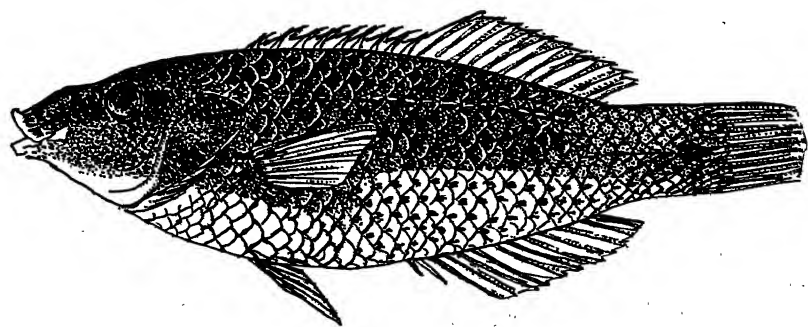


Fig. 9. *Stethojulis phaeodopleura* (Bleeker).

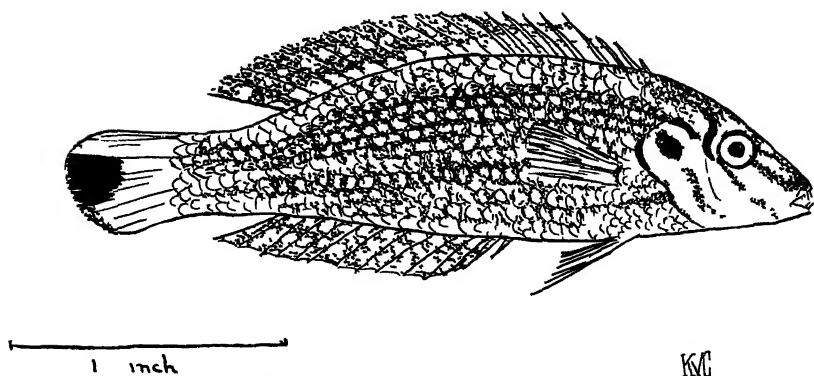


Fig. 10. *Halichoeres argus* (Bloch and Schneider), variety.

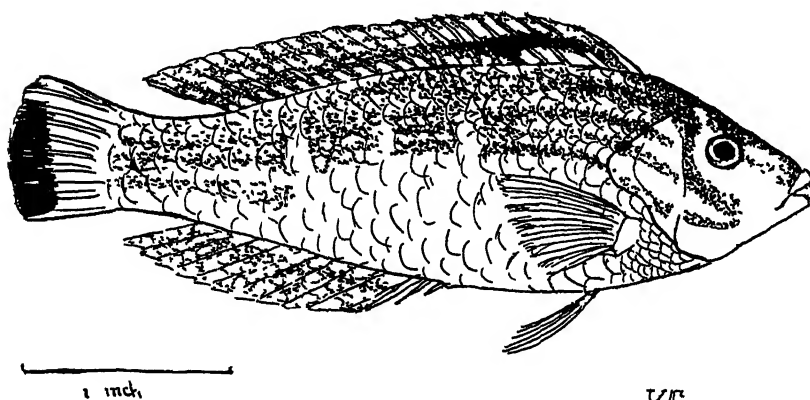


Fig. 11. *Halichoeres papilionaceus* (Cuvier and Valenciennes).

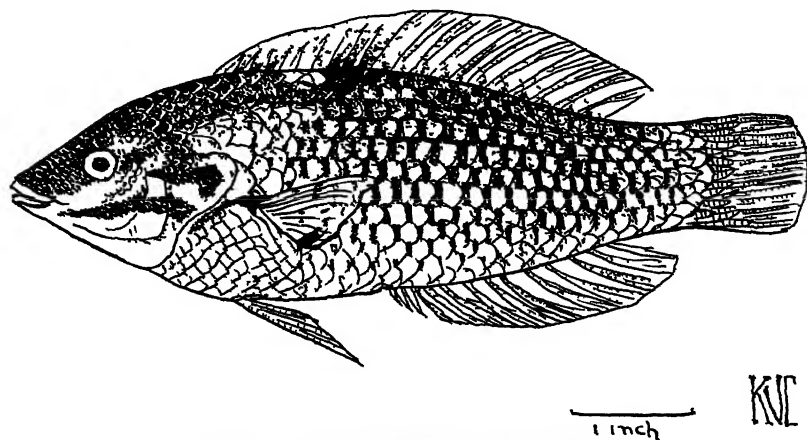


Fig. 12. *Halichoeres centiquadrus* (Lacépède).

darkening toward the tip, and with pale corners.

Halichoeres fijiensis Herre, also with the head markings of *H. argus* but the 3 black spots on dorsals and caudal base characteristic of *H. leparensis* (de Beaufort, 1940, p. 231, Fig.), de Beaufort synonymizes with *argus* and considers a hybrid with *leparensis*. Prior to examining the larger of our two specimens and studying the literature more carefully, I had thought the one of 52 mm. an undescribed form. Whereas I have now no hesitation in identifying it with *H. argus*, possibly a hybrid with *H. papilionaceus*, it is an interesting black-tailed variety of *argus* to be considered in further study of the intricate interrelationship which seems to pertain among several of these wrasses.

Both specimens have the black terminal patch in the center of the caudal. The smaller has head markings (Fig. 10) as figured for *H. argus*, in the larger the characteristic opercular blotch is present, the stripe slanting forward and downward from below eye lacking, that from eye to snout faint. Both have outer ventral rays produced making the fin notably long. In the smaller it reaches $5/7$, in the larger $7/8$ the distance to the anal origin. Both are slender, depth in standard length in the smaller specimen, 3.3, in the larger, 3.4.

As has been said, *H. leparensis* as figured by de Beaufort has a similar pattern of scale markings, and he recognized hybrids between this and *H. argus*. Two of our *H. leparensis* (all small) are comparable with his figure, as is also Bleeker's figure of *leparensis* (1862, Atl. Ichth., I, Pl. XLII, fig. 5), but most of ours are quite without this pattern and have a reduced number of vertical fin rays, as described for *H. leparensis* by Fowler (1928, Mem. Bishop. Museum, X, p. 342). *H. leparensis* (Bleeker), de Beaufort, is intermediate from *H. leparensis*, Fowler, Nichols, toward *H. argus*.

The single small specimen in the collection identified as *H. binotopsis* differs from our *H. leparensis* mainly in having a bold black bar on the base of the pectoral. This black bar is not duplicated in any

related member of the genus which I have seen.

CORIS LACÉPÈDE

We have 1 of the 5 species listed, *Coris gaimardi* (Quoy and Gaimard).

HOLOGYMNOSUS LACÉPÈDE

We have the one species listed, *Hologymnosus semidiscus* (Lacépède).

LEPTOSCARUS SWAINSON

We have the 2 species listed, *Leptoscarus coeruleopunctatus* (Ruppell) and *L. vaigiensis* (Quoy and Gaimard).

CRYPTOTOMUS COPE

We have the one species listed, *Cryptotomus spinidens* (Quoy and Gaimard).

CALLYODON BLOCH AND SCHNEIDER

We have 3 of the 46 species listed, *Callyodon bataviensis* (Bleeker), *C. forsteri* (Cuvier and Valenciennes) and *C. rubrovio-laceus* (Bleeker).

In any general collection of fishes from a given locality, some habitats and ecological niches are relatively well represented, others relatively poorly represented. The chances of occurrence of a particular fish in the collection increase with its abundance, also with the diversity of its habitats. Genera with more species should be not only more abundant in individuals than those with less, but should occupy more habitats. Hence it is in accordance with the laws of chance that only 8 of the 24 genera with from 1 to 3 species listed, are represented, 7 of the 8 with 5 to 12 species listed, both the two with 37 and 46 species listed.

On the other hand, one would not expect the individual species to be so abundant or of so general distribution in genera with more as in those with fewer species, hence not so high a per cent of them to be represented in a given collection. In the 8 genera represented with 1 to 3 species listed, 50 to 100 per cent of the species listed are represented. In the 7 genera represented with 5 to 12 species listed, in 4, 11 to 20 per cent of the species listed are represented, in 3, 33 to 75 per cent. In the genus *Halichoeres* with 37 species

listed, 32 per cent are represented; in the genus *Callyodon* with 46 listed only 7 per cent.

The 50 to 100 per cent in the first group (where less than a theoretical 33 per cent would mean non-representation), 33 to 75 per cent in the second group, and 32 per cent in the third group may be assumed to follow the law of probabilities for genera whose habitats are well represented in the

collection; the 11 to 20 per cent in the second group, 7 per cent in the third group for genera whose habitats are not. It will be noticed that the genera *Novaculichthys*, *Thalassoma*, *Stethojulis*, *Hali-choeres*, and in the parrots *Leptoscarus* and *Cryptotomus* (as compared with the often larger, more specialized *Callyodon* which is not), are well represented in this collection.

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MOUNTED SKELETON AND RESTORATION OF AN EARLY PALEOCENE MAMMAL

BY GEORGE GAYLORD SIMPSON

In 1913 Dr. Walter Granger found and collected a skeleton of *Ectoconus* in the lower fossil level of the Puerco Formation of Kimbetoh Arroyo, San Juan Basin, New Mexico, that is still, as far as we know,

nomenclature for this specimen. According to identifications made or let stand² by Matthew, the distribution of the 51 specimens known to him was as follows (all in the true Puerco):

	Lower level	Upper level	Totals with good records	Unknown level, in part doubtfully identified	Row totals
<i>E. ditrigonus</i>	7	2	9	34	43
<i>E. majusculus</i>	5	1	6	2	8
Column totals	12	3	15	36	51

the only nearly complete mammal skeleton ever found in Lower Paleocene strata. Since it is not only from the oldest known mammal-bearing Paleocene formation but also from its lowest fossiliferous stratum, this animal is a member of the earliest Tertiary fauna and the mount recently completed is much the oldest mounted mammal skeleton in any museum.

The late Dr. W. D. Matthew made this skeleton the type of *Ectoconus majusculus* Matthew, 1937, in his great posthumous publication on the San Juan Basin Paleocene.¹ There is some reason to believe that Matthew had misgivings about this species and he considered, but tentatively rejected, the possibility of its being based on a robust male of *E. ditrigonus*. From a cursory review of the problem, with additional specimens (68 in all were examined), I think this more likely than not. The problem merits more detailed attention, as do many anomalous cases of supposedly distinct but intergrading species found together (and, on the other hand, of supposedly identical species found in widely different strata and localities), but for the present we are retaining Matthew's

The bones of the skeleton here in question were kept separate for study and illustration until after the publication of Matthew's memoir, but they have now (completed April, 1941) been restored and mounted by Mr. Charles Lang, under the general supervision of Dr. Walter Granger, Dr. Edwin H. Colbert, and me. A life restoration of the animal alone, in pencil, and a larger, colored, habitat restoration in oils have been made by Mr. John C. Germann, under the same auspices.

Matthew's description of the skeleton and illustrations of its separate bones are so accurate and complete that further details are unnecessary. Despite its very great age and some crushing, the skeleton is remarkably complete. The only considerable parts missing are the lower jaw, spines of the vertebrae, possibly two lumbar, most of the caudals, pelvis, and much of the left scapula and left femur. For the most part these could be well restored from the other side of the same individual or from other specimens of the same species, leaving only the heights of the vertebral spines and the exact form of the pelvis subject to any serious doubt. Compari-

¹ Matthew, W. D., 1937, "Paleocene faunas of the San Juan Basin, New Mexico." Trans. Amer. Phil. Soc., (N.S.) XXX, pp. i-viii, 1-510. (*Ectoconus*, pp. 126-144.)

² But he apparently left many of Cope's identifications as *E. ditrigonus* without any detailed reexamination; these are in the "Unknown level" column.

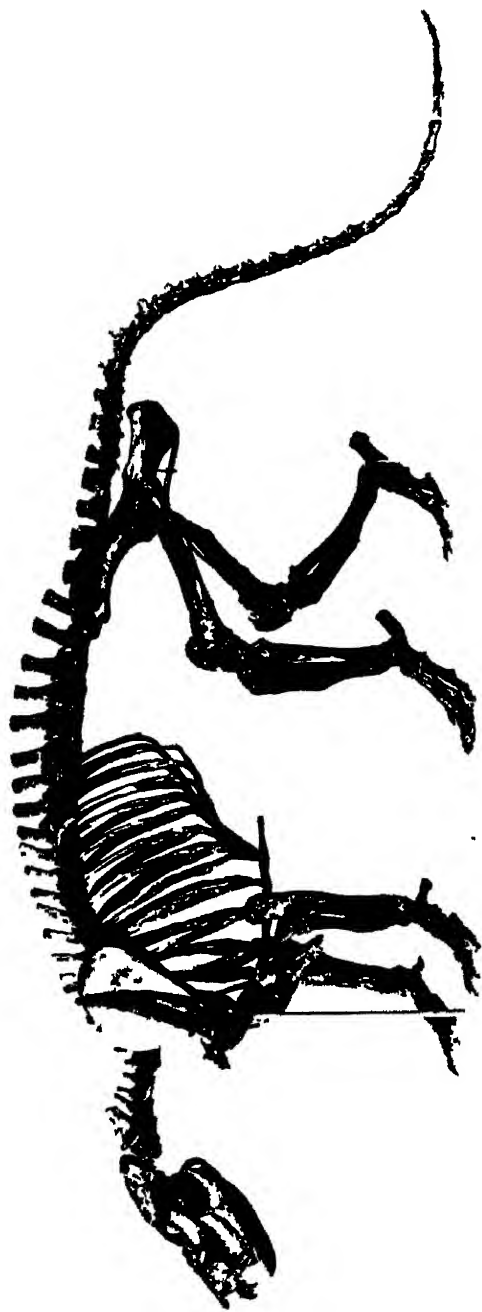


Fig. 1. *Ectoconus majusculus* Matthew, 1937. Amer. Mus. No. 16500, skeleton. Left lateral view. About $\frac{1}{3}$ of natural size, in plane of vertebrae.

son of the present photographs with those published by Matthew will show that much of the dorsoventral flattening of the anterior half of the skull was corrected but that the cranium is still smaller in this dimension than it was in the living animal. As far as possible these and other lesser imperfections due to crushing have been discounted in the life restorations.

The right elbow joint was severely damaged or diseased in life and, although it remained imperfectly functional, this must have made the animal very lame. This interesting pathology has, of course, been retained in the mount but has been omitted from the life restorations. The vertebral formula is uncertain and has been made cer.7, d.14, l.6, s.4, cau.24. Cervical and sacral counts are certain. Matthew suggested that some dorsals may be missing between the 12th and 13th as preserved, but with allowance for crushing the sequence of 14, as found, seems to

us to be continuous and complete. On the other hand Matthew thought that the 4 lumbar preserved might have formed the complete series, but on mounting there seemed to be a break between the 2d and 3d and we have inserted two plaster lumbar making 6 in all, which may not have been the exact number. The true number of caudals is unknown but the tail must have been long and heavy, about as restored.

Ectoconus was one of the largest mammals of its epoch although small in comparison with most living ungulates. The skeleton as mounted measures about $5\frac{1}{2}$ feet along the curve of the back from nose to tail, inclusive, and about 3 feet in a straight line from tip of nose to posterior margin of ischium. The upper margin of the scapula is $16\frac{3}{4}$ inches from the ground, so that the living animal was about $1\frac{1}{2}$ feet high at the shoulder.

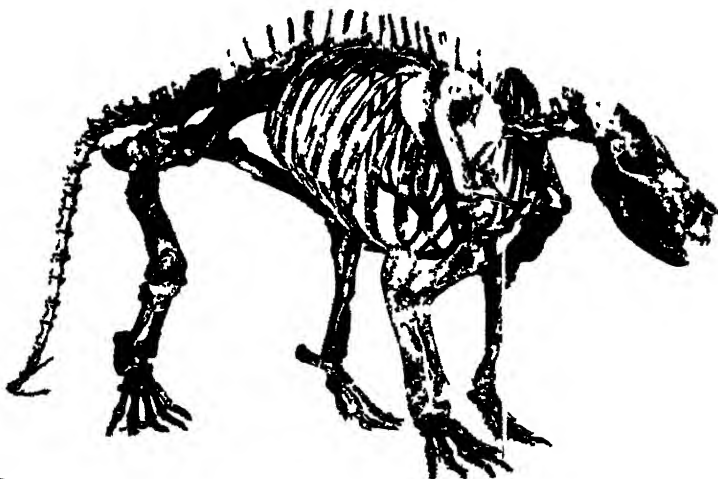


Fig. 2. *Ectoconus majusculus*. Same as Fig. 1. Right anterior oblique view. About $\frac{1}{3}$ of natural size, on right fore limb.

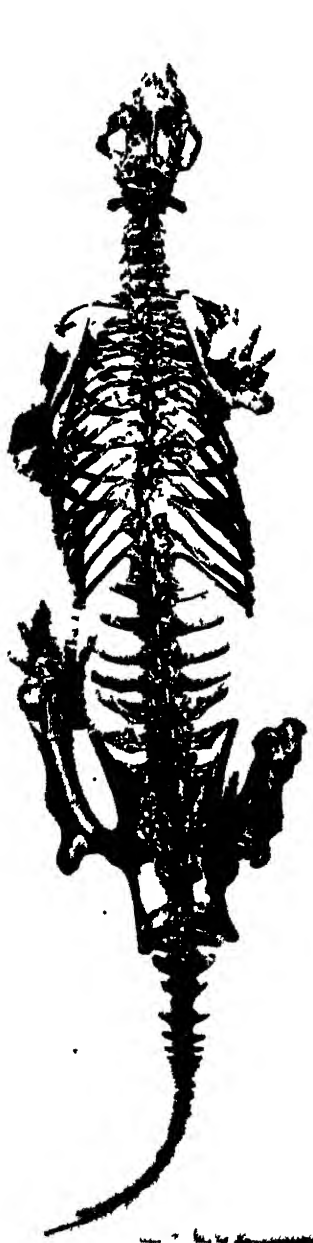


Fig. 3. *Ectoconus majusculus*. Same as Fig. 1. Dorsal view. About $\frac{1}{10}$ of natural size, in overall length.

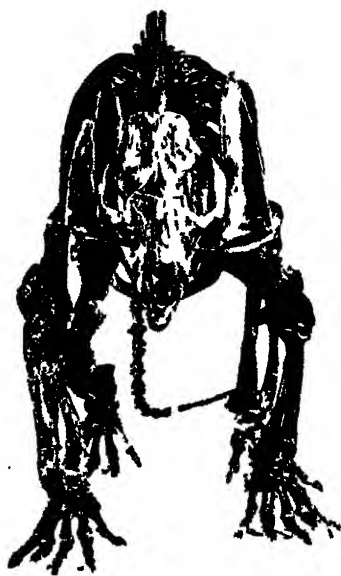


Fig. 4. *Ectoconus majusculus*. Same as Fig. 1. Anterior view. About $\frac{1}{10}$ of natural size, on zygomatic arches.

The polybunodont cheek teeth and the rather robust limbs must be taken as slight specializations on a low level, but on the whole *Ectoconus* is extraordinarily primitive. Discounting these minor peculiarities, it could serve as a diagram of a generalized, ancestral ungulate or, indeed, carnivore—as Matthew pointed out, some of the most primitive and early carnivores and ungulates are so much alike that it is hard to draw a sharp line between these great groups, later so widely divergent. This similarity is very striking in the lateral views of the *Ectoconus* skeleton, which could pass for a carnivore at first sight. There is, nevertheless, no doubt that *Ectoconus* is somewhat closer to the ungulate ancestry and represents a branch derived from (and by me referred to) the Condylarthra, most primitive of ungulate orders. Matthew likewise pointed out the remarkable resemblance of the skeleton of *Ectoconus* to that of the living aard-vark, aside from some mani-

festly adaptive specialization of the latter. A fossil *Orycteropus*, nearly like the living form, has recently been mounted in our laboratory and we were all struck by the similarity of *Ectoconus* as its skeleton was assembled immediately after that of *Orycteropus*.

Despite this structural resemblance, *Orycteropus* was not taken as a guide for the life restoration of *Ectoconus*. The skeletal differences that do exist are just those that would be most striking in a restoration and it seems unlikely that *Ectoconus* had acquired such characters, not deducible from the skeleton, as the enlarged external ears and reduced pelage of the aard-vark. In the restoration of *Ectoconus* Mr. Germann has faithfully

followed all the indications of the mounted skeleton and has been as non-committal as possible regarding most characters unrelated to the skeleton, showing a short, uniform pelage, generalized ears, and a snout with characters common to omnivorous animals of most nearly similar habitus. The stripes are an exception to this conservative stand and are, of course, entirely hypothetical,¹ but they help the modeling of the body and improve the artistic effect, without being contrary to possibility or susceptible to correction one way or the other.

(See figures 5 and 6 on following pages.)

¹ The argument that primitive mammals must have been striped like the young of a few modern species does not seem to me to have any great value for strictly scientific deduction.



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Fig 5 *Ectoconus mayusculus* Individual life restoration by J C Gemmann 1/3 actual size



Fig 6 *Ecdococcus macrocarpus*. Habitat restoration by J C Geimann. The trees most definitely indicated are similar to cab
bage palms desert palms tanbark oaks and sassaparilla allies of which have been found in beds of approximately this age. The
turle is a fronyard, not a scaled restoration of a particular species or specimen but representing *Aspidieria* a common genus
found in direct association with *Ecdococcus*

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A MIOCENE SLOTH FROM SOUTHERN CHILE

By GEORGE GAYLORD SIMPSON

The purpose of the present note is to describe a specimen that represents one of the most southern of known fossil mammals, one of the few Tertiary mammals known from Chile, a new species of a relatively rare and important genus and a fairly exact time marker for an imperfectly known and hitherto uncertainly dated

sequence of Tertiary strata. I am indebted to Mr. Junius Bird for the opportunity to describe his discovery and for field data concerning it, to Mr. Albert Thomson for preparation of the specimen, and to Mr. John C. Germann for the accompanying drawing.

TAXONOMY

ORDER EDENTATA CUVIER, 1798

SUBORDER XENARTHRA GILL, 1884

FAMILY MYLODONTIDAE AMEGHINO, 1889

Subfamily Mylodontinae Gill, 1872

GENUS NEMATHERIUM AMEGHINO, 1887

Nematherium birdi,¹ new species

TYPE.—Amer. Mus. No. 32652, imperfect skull with upper dentition, lacking the first two teeth on the left side.

HORIZON AND LOCALITY.—Isolated exposure of the Palomares or Santa Cruz formation, evidently of Santacrucian age (early Miocene?), on the east side of Laguna Blanca, Department of Magallanes, southern Chile.

DIAGNOSIS.—A relatively large *Nematherium*, intermediate in size between *N. auca* and *N. profundatum*. First upper tooth well developed, reniform. Second to fourth teeth subequal; second and third rounded, vaguely triangular, strongly oblique; fourth obliquely quadrate. Last upper tooth elongate transversely. Palate probably narrow throughout.

AFFINITIES AND CHARACTERS

It is evident that this specimen represents an early mylodontid ground sloth comparable in degree of evolution with the rare mylodontids from the Santa Cruz formation of Argentine Patagonia, to the north of this locality.

Ameghino (collected works or references in Scott, 1904, plus Ameghino, 1904, cited below) placed the Santa Cruz mylodontids in five genera: *Nematherium*, *Ammotherium*, *Lymodon*, *Analcitherium*, and *Scelidotheirops*. The last was published at about the same time as Scott's revision (1904) of

these forms and so is not mentioned in it. Of the other four, Scott considered *Ammotherium* and *Lymodon* as synonyms of *Nematherium* and suggested that *Analcitherium* might be a juvenile *Nematherium* but tentatively retained it on the basis of its less divergent tooth rows, more parallel sides of rostrum, and shorter preorbital region. Because of lateral crushing and loss of the tip of the rostrum, our specimen does not show the supposed generic distinctions. The teeth are, however, somewhat more like specimens placed by Scott in *Nematherium* and this fact, together

¹ For Junius Bird, who found the specimen.

with the doubts as to the status of *Analcitherium*, warrants reference to *Nematherium* as between these two. *Scelidothériops* was based on one mandibular fragment with a single tooth and two alveoli. It was not figured and the description makes no direct comparisons with any contemporaneous genus. The validity and nature of *Scelidothériops* thus are doubtful and must remain so until the necessary comparisons are published or better specimens are found. Direct comparison with our specimen, and with some other pertinent types, is impossible on the basis of the known material.

Possible pre-Santacrucian mylodontids are represented only by isolated teeth, as far as I know, quite different from those

and does not further enter into the present inquiry. The remaining nine species recognized by Ameghino were reduced by Scott to five: *Analcitherium antarcticum*, *Nematherium angulatum* (all of the four species referred to *Nematherium* by Ameghino and by Mercerat), *N. auca* (Ameghino's two species of *Lymodon*), *N. profundatum* (two of Ameghino's species of *Ammotherium*), and *N. declivum* (Ameghino's third species of *Ammotherium*). The variation is such that even the species recognized by Scott, essentially Ameghino's genera, are hardly distinguishable when all the known specimens are compared and yet show great variation in minor and probably individual characters. They are thus poorly defined and of uncer-



$\frac{1}{2}$
A.M. 32652 Type

Fig. 1.—*Nematherium birdi*, new species. Type, Amer. Mus. No. 32652, imperfect skull with upper dentition. Right lateral view of skull and crown view of teeth of right side. One-half natural size.

of the present specimen and only doubtfully related. The post-Santacrucian form nearest in time and in relationships is *Neonematherium*, based on a single specimen described without illustration by Ameghino (1904) and illustrated without description by Rovereto (1914). It is definitely more advanced than our fossil and certainly not congeneric.

Ameghino described ten species of Santa Cruz mylodontids (almost every identifiable specimen becoming a specific type) and Mercerat described one, *Nematherium lavagnanum*, which Ameghino considered (correctly, in Scott's opinion and in mine) as a synonym of his *N. longirostre*. *Scelidothériops arunculus* is not well comparable

tain validity and limits, as Scott recognized. As with many other Santa Cruz species, proper definition and revision can only be made when good series of specimens of limited and exactly known horizons and localities become available.

The forms of the teeth of the present specimen are distinctly outside the range of those previously described among Santa Cruz mylodontids, so that there is considerable probability that it does represent a new species, whatever may be the correct synonymy of those previously described. In size the teeth fall between *N. auca*, the largest supposed species, and *N. profundatum*, but this has no clear taxonomic significance since all previously de-

scribed species, with the possible exception of *N. declivum*, show no greater differences in size than often occur in a single species.

Instead of the cylindrical to subtriangular form seen in all the specimens referred by Scott to *Nematherium*, the first upper tooth is reniform in section, elongate anteroposteriorly, convex on outer, anterior, and posterior faces and concave on the inner face. This one tooth is somewhat suggestive of *Analcitherium antarcticum*, although the rest of the dentition is more as in *Nematherium*. Although subtriangular, the second and third teeth are more oval and more elongate and oblique in section than in previously described species. The fourth tooth is not triangular but obliquely quadrate in section, a striking and probably significant distinction from all previously described specimens. This character is somewhat approached only in the dentition referred by Ameghino to *Ammotherium profundatum* and regarded by Scott as possibly representing an unnamed species (figured by Scott 1904, pl. LXII, fig. 5). The last upper tooth is also strikingly distinctive in being transverse,

i.e., wider than long in section, while in all previously known species of *Nematherium* it is elongate anteroposteriorly.

Crushing and decay have obscured the palatal characters, but from what remains it is possible that the palate was narrower throughout than in *Analcitherium* and narrower anteriorly than in specimens previously referred to *Nematherium*. Although much of the skull is present, it reveals no characters definitely distinctive from contemporaneous mylodontids and adds nothing to knowledge of structure as already described by Scott.

Differences of this specimen from other mylodontids of like age do not appear to suggest special relationships to any one later genus. Indeed I doubt whether the attempts made to distinguish such phyletic relationships among the scanty remains of Santa Cruz mylodontids have any objective value. These early mylodontids only ring changes within a limited genetic repertory and do not seem yet to have split into recognizably distinct lines within the family. In a general way they are all, as a group, structurally ancestral to all the later mylodontids.

MEASUREMENTS

Measurements of teeth of such irregular form and oblique orientation are difficult and have a large personal factor. As nearly as possible the following measurements of single teeth are in a plane transverse to the long (more or less vertical) axis of the tooth, the length between lines tangential to the tooth and at right angles to the vertical middle plane of the skull and the width between similar tangents parallel to that plane. Measurements are in millimeters.

Total length of upper dentition.....	ca. 50
	(somewhat altered by crushing)
First upper tooth, length	8.8
“ “ “ width.....	6.2
Second “ “ length	9.9
“ “ “ width	8.4
Third “ “ length.....	9.8
“ “ “ width.....	9.2
Fourth “ “ length.....	9.8
“ “ “ width.....	9.3
Fifth “ “ length.....	7.5
“ “ “ width.....	8.5

OCCURRENCE AND AGE

This specimen was found in January, 1936, by Mr. Junius Bird while making an archaeological exploration for this Museum. The locality is on the mainland of southern Chile, in the Department of Magallanes, in about Long. $71^{\circ} 61'$ west, Lat. $52^{\circ} 26'$ south, about 80 kilometers north and slightly west of the town of Magallanes (Punta Arenas) and about 50 kilometers south of the Chilean-Argentine boundary (here running east-west). The exact spot is east of Laguna Blanca,¹ in Cañadón la Leona, a small watercourse flowing into the lake basin from the east and slightly south of the middle of the lake. It lies less than a kilometer (about five minutes' walk) east of the trail along this side of the lake and between that trail and the well-marked Pleistocene lake terraces that bound the lake basin. These indications permit precise localization on the map published by Caldenius, 1932, Pl. XII, and also on the Tierra del Fuego sheet of the International Millionth Map (Amer. Geog. Soc., 1930) where, however, the cañadón is marked "Cilo. [i.e., Chorrillo] de Las Lomas," either in error or on some authority contrary to the local usage. By coincidence a photograph published by Guinazú (1940, p. 23, upper figure) shows not only the locality but also the precise block of rock from which the fossil came (the right of the two blocks most prominent in the left half of his picture) as well as a rock shelter (right half of photograph) which contained artifacts and attracted Mr. Bird's attention to this spot.² There is here a small exposure of the local bedrock, a gray tuff, which elsewhere in this region is hidden by glacial and other relatively recent deposits. The fossil was in a block of this tuff that had fallen from an overhanging ledge immediately above.

From the fossil, itself, the rock in question can be confidently designated as

Santaacrucean in age, hence probably Lower Miocene (see Simpson, 1940). The genus has never been reported from beds of any other age and while this find belongs to a new species, it is not evidently more advanced or more primitive than species found in the typical Santa Cruz of Argentine Patagonia. The only possibly close relatives from earlier beds are the octodontines, quite distinctive and probably not directly ancestral, while *Neonematherium* from the somewhat later Friasian is definitely more advanced in structure. Santaacrucean time probably was of considerable duration and rocks of this age may be expected to have distinguishable successive faunules, but lack of modern, careful field data has prevented the recognition of these even in the richly fossiliferous and thick type Santa Cruz and there is no basis for more exact placing of this isolated find. The fact that this casual discovery is of a new species of a genus rare in the rich fossil beds farther north may reflect some small difference of age, facies, or both.

Ameghino (1906, Fig. 57) showed the Santa Cruz beds as extending into Chile in this region, but not as far as Laguna Blanca. He did not, to my knowledge, record any Santaacrucean fossils from Chile or state the nature of his evidence. Hemmer (1935) recorded the presence of *Astrapotherium magnum* (identified by Dr. C. L. Gazin, Washington) in what he calls the Palomares beds at Los Cruceros on the southern margin of the Laguna del Toro. This locality is some 38 kilometers almost due south (slightly west) of the locality of the fossil described in this paper and is approximately in latitude $52^{\circ} 46'$ south, about twenty minutes of latitude farther south than our specimen. *Astrapotherium magnum* is a Santaacrucean species³ and Hemmer therefore correlates his Palo-

¹ Many different lakes have this name in southern South America. This is not to be confused with the Friasian fossil locality, Laguna Blanca, in extreme southwestern Chubut Territory, Argentina.

² In view of the confused reports on the antiquity of man in South America, it may be well to emphasize that the artifacts are many millions of years younger than this fossil and that their proximity is pure coincidence.

³ Hemmer quotes Gazin as saying that it is also Friasian, but the Friasian materials were not definitely referable to that species and have subsequently been placed in an exclusively Friasian species, *A. hesperinum* Cabrera, 1940. The genus ranges from Coluehuapian to Friasian, inclusive, a considerable span both earlier and later than Santaacrucean. Hemmer's specimens are very fragmentary and the specific reference and therefore also the stratigraphic correlation are presumably uncertain.

mares beds with the Santa Cruz formation of adjacent Argentina. There is considerable probability that *Nematherium birdi* is from the same beds, although the isolated exposures have not been and probably cannot be correlated stratigraphically, and it should be recorded as a second Palomares species if the distinction between Palomares and Santa Cruz merits retention. As far as I know, Hemmer's is the only previous record of a mammal of comparable age from Chile and is also the most southern of all known Tertiary mammals.¹

Guinazú (1940) noted the presence of tuffs north, east, and west of Laguna Blanca, including the exposure where *Nematherium birdi* was found, as previously mentioned. He called these "formacion Santacruciana," presumably on lithologic grounds since he mentioned no fossils. The present discovery confirms and strengthens both Hemmer's and Guinazú's correlations.

The occurrence of a sloth at this high latitude, where the climate is now bitterly cold, is a striking fact. Recent tree sloths are strictly tropical, but there is evidence that the ground sloths tolerated temperate, even cold temperate, climates. In North America *Myiodon*, a descendant of *Nematherium*, ranged to at least 48°

north during the Pleistocene and at the same time, as well as probably into the geological Recent epoch, other descendants or allies ranged about as far south as the locality of *Nematherium birdi*. The famous cave at Ultima Esperanza is only about one degree farther north. It is also significant that one endentate (*Zaedyx*, the pichy armadillo) still ranges into the cold climate of southern Patagonia. Even such relatively poikilothermous mammals as the Xenarthra may thus be inconclusive climatic markers. Some of the peculiarities of the Patagonian fossil record, such as the absence of tree sloths and the rarity and late, brief appearance of primates and anteaters, might be explicable if the climate of Patagonia had been continuously more inclement than that of more equatorial regions where the main evolution of some South American animals probably occurred. It is, however, possible and it is congruent with the inconclusive evidence of the present discovery that the Patagonian climate may have been relatively mild in Santacrucian time, without being tropical. Thus primates and anteaters occurred in these lower latitudes only during or about that time, as far as now known, and Berry concludes that floras of approximately Santacrucian age and extending to about 51° south indicate more or less warm temperate conditions, warmer than at present in the same latitudes.

¹ Feruglio (1938) mentions the occurrence of presumably Santacrucian exposures farther south, in Tierra del Fuego, to about latitude 53½° south, but I have seen no record of mammals found in these exposures.

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